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# Cassava Agronomy Research Activities in Daklak

“Developing value-chain linkages to improve smallholder cassava production systems in Vietnam and Indonesia  
**Tay Nguyen University Component**”



**Nguyen Van Minh, CuThi Le Thuy,  
Dominic Smith, Jonathan Newby, Nguyen Van Nam and et all.**

**Vientiane, Jan 2018**

# Outline

## \* Introduction and objectives

### \* Activities implemented

- Training and Selection of trials
- Designing of trials
- Establishment of trials

### \* Trial results

- Variety trial
- Fertilizer trial
- Survey pests on cassava
- Harvesting field days

### \* Challenges and constraints

### \* Plan for 2018



# Cassava in Dak Lak

- 35.000 Ha
- 20 ton/ha
- 720,741 ton/year

5 starch factory  
1 ethanol factory  
(Dak Nong)

- The yield/ha is low and decreasing (20 ton/ha, potential over 30tan/ha)
- Low starch and focusing harvest time
- Soil erosion
- Pests and new pests on high yield varieties











- **Adoptation new Varieties with high yeild**
- **Manage Soil degradation of soil fertility with apply fer and muching crops**
- **Pest and disease management**
- **Increase economic and profits for all actors along the value chain**
  - Increase sustainability of cassava production system





# Activities implemented 2017



# Stakeholders participating in the Project

- TNU with the participation of farmers
- Extension workers
- Cassava traders
- Processors
- Representatives from Daklak Department of Agricultural and Rural Development (DARD).
- Two master students are involved in the trials and used data collected from variety evaluation and fertilizer and density trials in KrongBong district in their dissertations.
- Undergraduate Students



# Trials in 2017

No	TRIALS	Number of varieties	Location	
			Village	Commune
I	<b>VARIETY TRIALS</b>			
	<b>KrongBong district</b>			
	Infertile acrisols			
1	- MARD practice	7	Village 5	CuKty
2	- Farmer's practice	6	Village 5	CuKty
	Ferrasols			
3	- MARD practice	7	Cuenam A	Dang Kang
4	- Farmer's practice	6	Ngo B	Hoa Phong
	<b>Eakar district</b>			
	Sandy acrisols			
5	- MARD practice	6	Village 3	Easar
6	- Farmer's practice	6	Village 3	Easar
II	<b>FERTILISER AND PLANT DENSITY TRIALS</b>			
	<b>KrongBong district</b>			
7	Infertile acrisols	1	Village 5	CuKty
8	Ferrasols	1	Ngo B	Hoa Phong
	<b>Eakar district</b>			
9	Sandy acrisols	1	Village 3	Easar

**Varieties Evaluation Experiments:** 7 varieties are evaluated in two different type of soils – Acrisols and Ferrasols in Dang Cang commune. Planted in April 2017 and harvested in December 2017.

## **Number of evaluated varieties: 7 including:**

Treatment 1 (T1): **KM94** control treatment (combination of Rayong 1 x Rayong 90) (control). Expected starch content: 27.4%-29% after 10-12 months

Treatment 2 (T2): **KM419** (BKA900x KM98-5)

Treatment 3 (T3) **KM140**, (KM98-1 x KM3). Expected starch content: 27.2%-29.3% after 7-10 months

Treatment 4 (T4): **Rayong 9 also called KM 21-12**. Expected starch content: 28%-29.1%

Treatment 5 (T5): **KM505**

Treatment 6 (T6): **HL-S10**

Treatment 7 (T7): **HL-S11** (Muted SM937-26 by Co60)



# Fertilizer experiment design:

15 treatments including:

- 3 density treatments (M1, M2, M3)
- 4 fertilizer treatments (P1, P2, P3, P4) benchmark with MARD's standard
- 2 fertilizer treatments reflect farmer's practice (P0 and P5) (100kg phosphorous fertilizer and 250kg NPK (15-5-20). Details as below:

## Density

**M1: 0,8m x 0,8m (16500/ha)**

**M2: 0,8m x 1m (12500/ha)**

**M3: 1m x 1m (10.000/ha)**

## Fertilizers

**P1** (90N+60P<sub>2</sub>O<sub>5</sub>+90K<sub>2</sub>O)  
(Benchmark with MARD standard)

**P2** (99N+66P<sub>2</sub>O<sub>5</sub>+99K<sub>2</sub>O):  
Density remained + 10% fertilizer

**P3** (108N+72P<sub>2</sub>O<sub>5</sub>+108K<sub>2</sub>O):  
Density remained+20% fertilizer

**P4** 117N+78P<sub>2</sub>O<sub>5</sub>+117K<sub>2</sub>O):  
Density remained+30% fertilizer

**P5** (100kg phosphate fertilizer +  
250kg NPK (15-5-20)

**P0**=(0.8m x 0.8m) x no fertilizer

# Implementing cassava variety experiment





## *Biomass yield and harvest index of evaluated varieties in ferrasol and acrisol soil types*

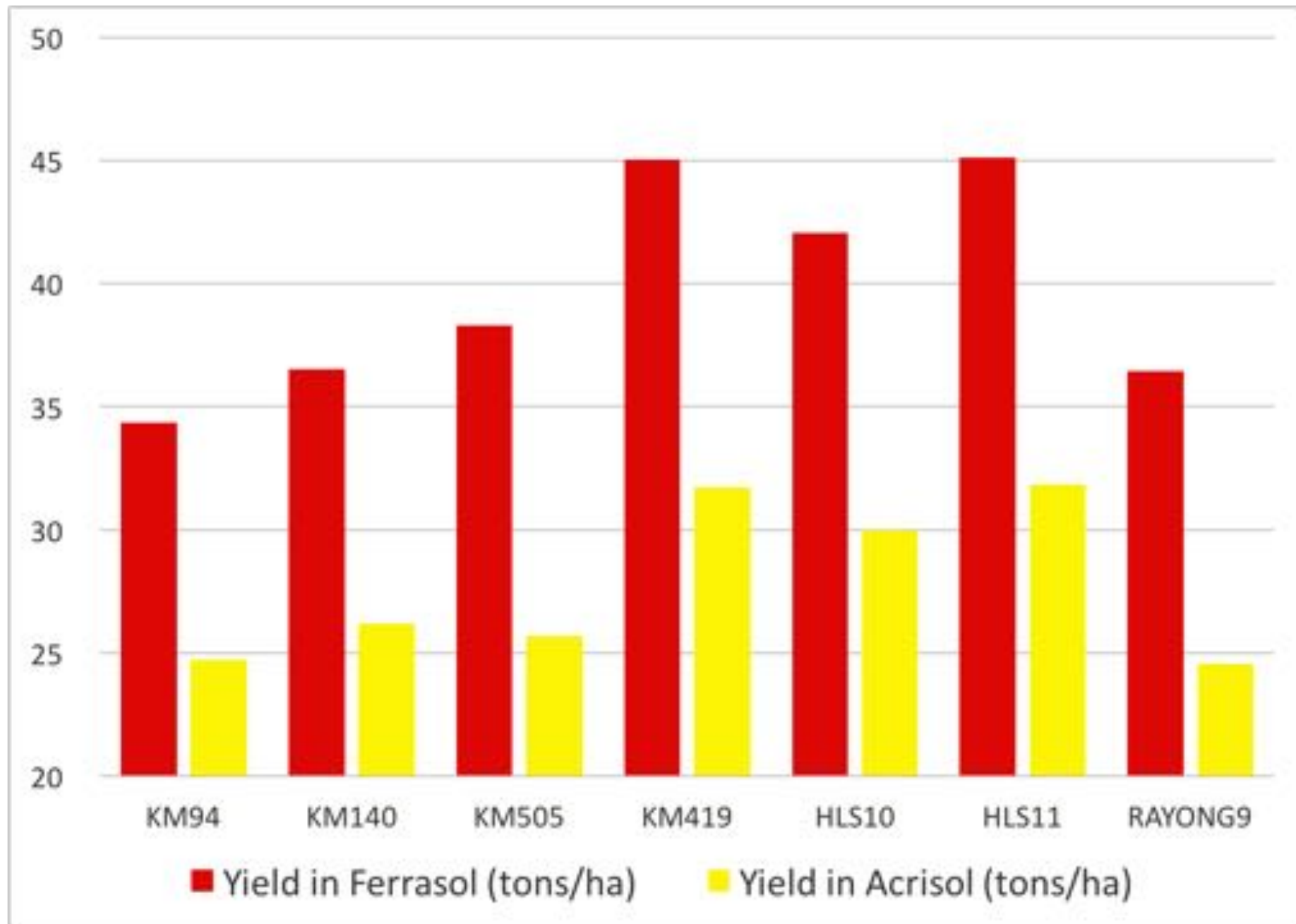
Varieties	Ferrasol						Acrisol					
	# root per plant (roots)	Weight of root per plant (kg)	Fresh root yield (t/ha)	Stem & leaf yield (t/ha)	Biomass yield (t/ha)	Harvest Index (%)	# root per plant (roots)	Weight of root per plant (kg)	Fresh root yield (t/ha)	Stem & leaf yield (t/ha)	Biomass yield (t/ha)	Harvest Index (%)
KN194 (control)	7.57	2.75	34.37	21.57	55.93	61.44	5.97	2.27	24.73	17.67	42.40	56.66
KN140	8.77	2.92	36.53	21.20	57.73	63.26	6.93	2.51	26.20	18.63	44.83	58.07
KN505	8.00	3.06	38.30	21.53	59.83	63.82	6.67	2.39	25.67	18.77	44.43	59.33
KN419	10.10	3.60	45.03	19.27	64.30	70.04	8.43	3.15	31.73	20.97	52.70	66.67
HLS10	8.87	3.37	42.07	21.20	63.27	66.47	7.87	2.80	30.00	19.30	49.30	60.20
HLS11	9.10	3.61	45.13	20.33	65.47	68.94	7.83	3.01	31.83	20.77	52.60	66.03
RAYON09	8.70	2.91	36.43	21.97	58.40	62.38	7.37	2.42	24.57	17.80	42.37	57.61

# Cassava yield of evaluated varieties on ferrasol and acrisol soil types

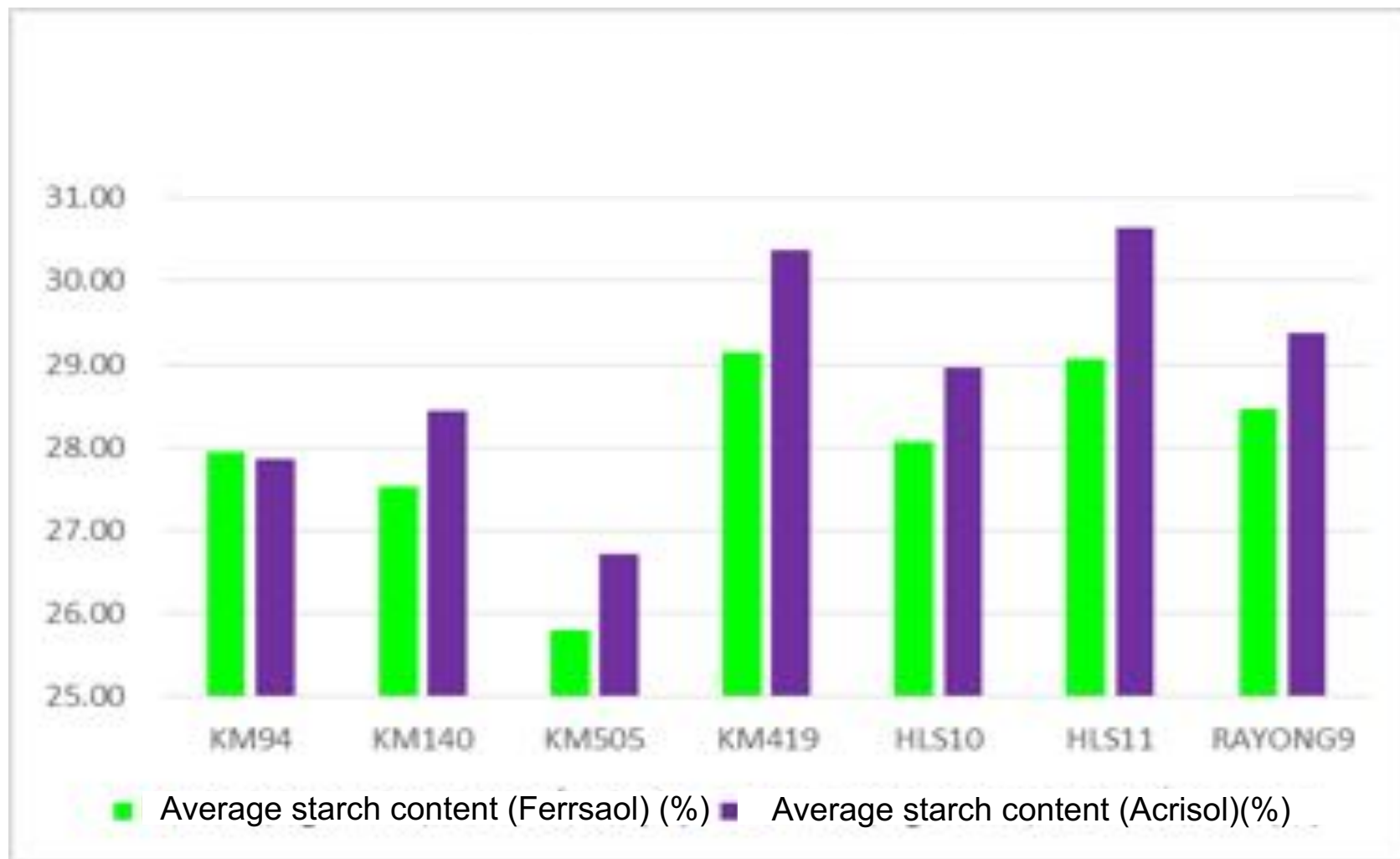
Varieties	Ferrasol					Acrisol				
	Dry matter content (%)	Starch content (%)	Fresh root yield (t/ha)	Dry root yield (t/ha)	Starch yield (t/ha)	Dry matter content (%)	Starch content (%)	Fresh root yield (t/ha)	Dry root yield (t/ha)	Starch yield (t/ha)
KM94(control)	39,90 <sup>na</sup>	27,95 <sup>na</sup>	34,37 <sup>c</sup>	15,37 <sup>b</sup>	9,60 <sup>c</sup>	38,90 <sup>na</sup>	27,85 <sup>ab</sup>	24,73 <sup>na</sup>	13,47 <sup>c</sup>	6,89 <sup>ab</sup>
KM140	39,90 <sup>na</sup>	27,53 <sup>na</sup>	36,53 <sup>bc</sup>	17,77 <sup>ab</sup>	10,07 <sup>bc</sup>	38,60 <sup>na</sup>	28,43 <sup>ab</sup>	26,20 <sup>na</sup>	14,20 <sup>bc</sup>	7,45 <sup>ab</sup>
KM505	41,20 <sup>na</sup>	25,81 <sup>na</sup>	38,30 <sup>ab</sup>	18,53 <sup>ab</sup>	9,84 <sup>bc</sup>	40,40 <sup>na</sup>	26,71 <sup>b</sup>	25,67 <sup>na</sup>	14,63 <sup>ab</sup>	6,85 <sup>b</sup>
KM419	41,60 <sup>na</sup>	29,15 <sup>na</sup>	45,03 <sup>a</sup>	20,97 <sup>a</sup>	13,12 <sup>a</sup>	39,80 <sup>na</sup>	30,38 <sup>a</sup>	31,73 <sup>na</sup>	17,90 <sup>a</sup>	9,59 <sup>a</sup>
HLS10	40,20 <sup>na</sup>	28,06 <sup>na</sup>	42,07 <sup>ab</sup>	17,60 <sup>ab</sup>	11,82 <sup>ab</sup>	38,70 <sup>na</sup>	28,96 <sup>ab</sup>	30,00 <sup>na</sup>	15,70 <sup>abc</sup>	8,69 <sup>ab</sup>
HLS11	42,20 <sup>na</sup>	29,07 <sup>na</sup>	45,13 <sup>a</sup>	19,13 <sup>a</sup>	13,12 <sup>a</sup>	40,10 <sup>na</sup>	30,64 <sup>a</sup>	31,83 <sup>na</sup>	17,23 <sup>ab</sup>	9,74 <sup>a</sup>
RAYONG9	40,50 <sup>na</sup>	28,47 <sup>na</sup>	36,43 <sup>bc</sup>	17,90 <sup>ab</sup>	10,37 <sup>bc</sup>	38,20 <sup>na</sup>	29,37 <sup>ab</sup>	24,57 <sup>na</sup>	15,00 <sup>abc</sup>	7,21 <sup>ab</sup>
CN%	3,04	5,36	11,68	10,79	14,14	5,75	5,66	15,29	12,00	17,33



# Variety trials in Krong Bong: Fresh root yields

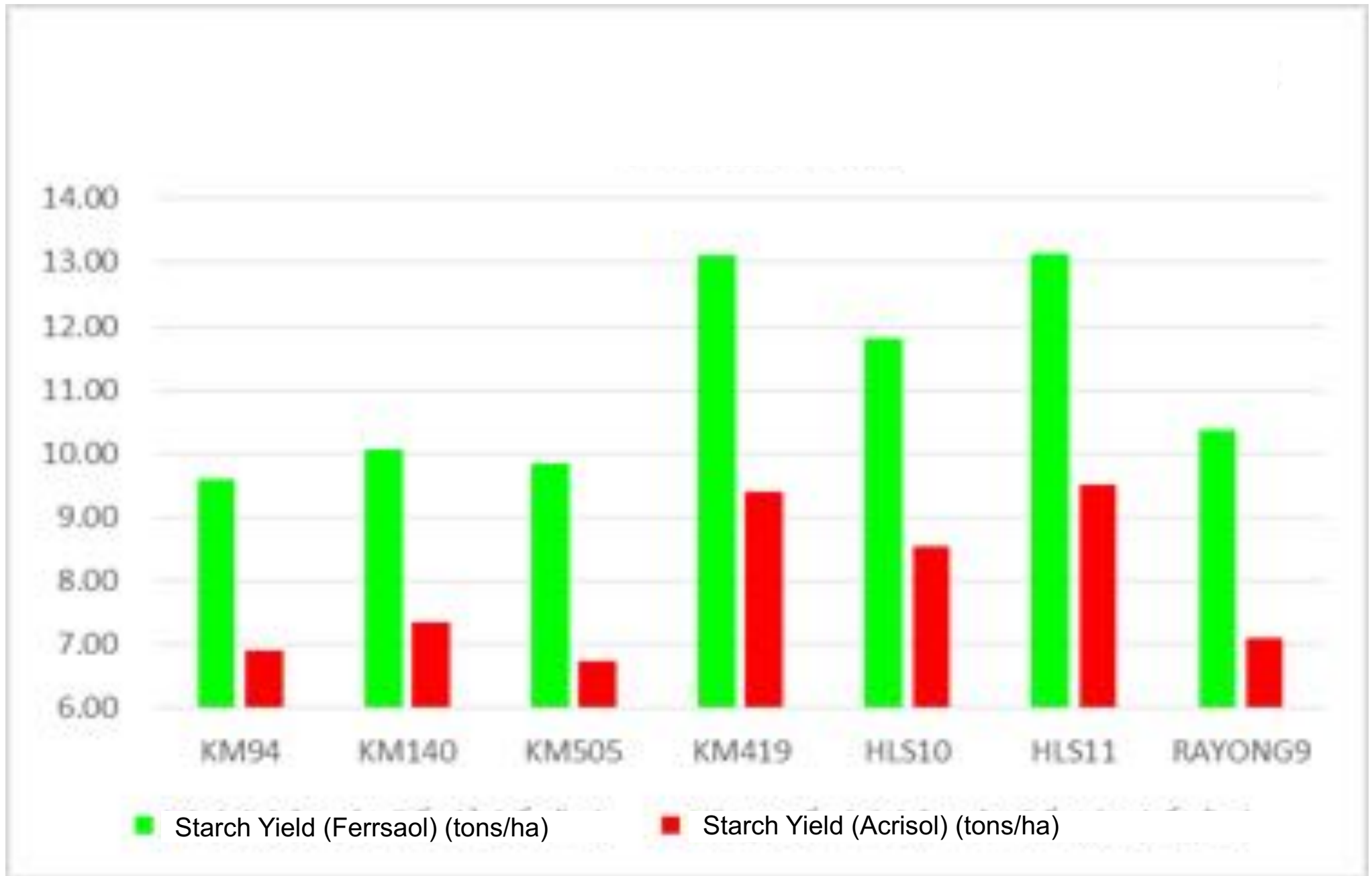


# Variety trials in Krong Bong: Starch content





# Varieties trials in Krong Bong: Starch yield



*Possible income gained with evaluated varieties in ferrasol and acrisol soil types*

Varieties	Ferrasol						Acrisol					
	Fresh root yield (t/ha)	Starch content (%)	Unit price (mill VND/t)	Gross income (mill VND)	Production cost (mill VND)	Net income (mill VND)	Fresh root yield (t/ha)	Starch content (%)	Unit price (mill VND/t)	Gross income (mill VND)	Production cost (mill VND)	Net income (mill VND)
KM94 (control)	34.37	27.95	1.90	65.30	27.70	37.60	24.73	27.85	1.90	46.99	27.70	19.29
KM140	36.53	27.53	1.90	69.41	27.70	41.71	26.20	28.43	1.90	49.78	27.70	22.08
KM505	38.30	25.81	1.85	70.86	27.70	43.16	25.67	26.71	1.85	47.48	27.70	19.78
KM419	45.03	29.15	1.90	85.56	27.70	57.86	31.73	30.38	1.90	60.29	27.70	32.59
HLS10	42.07	28.06	1.90	79.93	27.70	52.23	30.00	28.96	1.90	57.00	27.70	29.30
HLS11	45.13	29.07	1.90	85.75	27.70	58.05	31.83	30.64	1.90	60.48	27.70	32.78
RAYONG®	36.43	28.47	1.90	69.22	27.70	41.52	24.57	29.37	1.90	46.68	27.70	18.98



# New cassava varieties



Rayong: 36/24

HLS10: 42/30

HLS11: 45/31



KM 419: 45/31ton

KM 505: 38/25 ton/ha

KM 140: 36/26 ton/ha



# Fertilizer and density trials on KM 419





# Implementing Fertilizer and density experiment on KM 419



# *Fresh root yields in different densities and fertilizer treatments*

Fertilizer level	15,625 plants/ha			12,500 plants/ha			10,000 plants/ha		
	# root per plant (roots)	Weight of root/plant (kg)	Fresh root yield (t/ha)	# root per plant (roots)	Weight of root/plant (kg)	Fresh root yield (t/ha)	# root per plant (roots)	Weight of root/plant (kg)	Fresh root yield (t/ha)
90N-60P <sub>2</sub> O <sub>5</sub> -90K <sub>2</sub> O	7.63 <sup>abcd</sup>	2.23 <sup>def</sup>	34.77 <sup>bc</sup>	7.70 <sup>abc</sup>	3.27 <sup>def</sup>	40.87 <sup>ab</sup>	8.67 <sup>ab</sup>	4.13 <sup>ab</sup>	41.27 <sup>ab</sup>
99N-66P <sub>2</sub> O <sub>5</sub> -99K <sub>2</sub> O	7.70 <sup>abc</sup>	2.28 <sup>def</sup>	35.67 <sup>abc</sup>	7.97 <sup>ab</sup>	3.23 <sup>def</sup>	40.37 <sup>ab</sup>	8.10 <sup>ab</sup>	4.16 <sup>ab</sup>	41.57 <sup>ab</sup>
108N-72P <sub>2</sub> O <sub>5</sub> -108K <sub>2</sub> O	7.70 <sup>abc</sup>	2.43 <sup>cdef</sup>	38.00 <sup>ab</sup>	9.07 <sup>a</sup>	3.25 <sup>def</sup>	40.60 <sup>ab</sup>	9.30 <sup>a</sup>	4.42 <sup>a</sup>	44.20 <sup>a</sup>
117N-78P <sub>2</sub> O <sub>5</sub> -117K <sub>2</sub> O	8.40 <sup>ab</sup>	2.52 <sup>cdef</sup>	39.40 <sup>ab</sup>	7.90 <sup>abc</sup>	3.32 <sup>bc</sup>	41.24 <sup>ab</sup>	9.37 <sup>a</sup>	4.48 <sup>a</sup>	44.83 <sup>a</sup>
No fertilizer	5.33 <sup>gh</sup>	1.26 <sup>f</sup>	19.65 <sup>d</sup>	4.16 <sup>f</sup>	2.23 <sup>def</sup>	20.44 <sup>d</sup>	4.11 <sup>f</sup>	2.08 <sup>gh</sup>	20.81 <sup>d</sup>
Farmers practice	6.15 <sup>efgh</sup>	1.71 <sup>gh</sup>	26.67 <sup>ef</sup>	4.74 <sup>ef</sup>	2.85 <sup>def</sup>	23.70 <sup>d</sup>	4.15 <sup>f</sup>	2.35 <sup>efgh</sup>	23.49 <sup>d</sup>



# Starch content, starch yield and dry root yield in different densities and fertilizer amount (ton/ha)

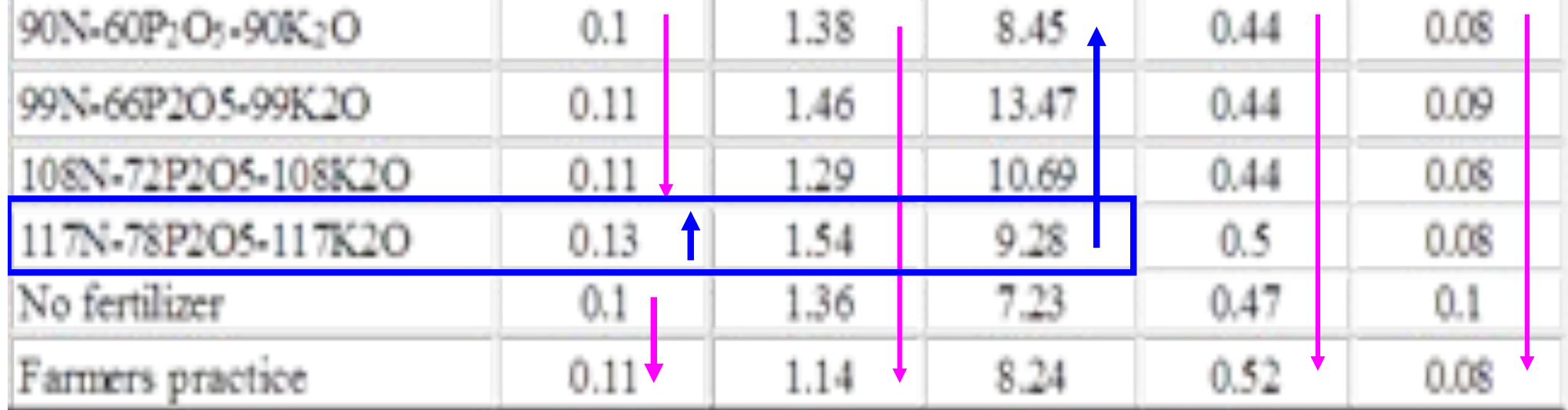
Fertilizer level	15,625 plants/ha				12,500 plants/ha				10,000 plants/ha			
	Dry matter content (%)	Starch content (%)	Starch yield (t/ha)	Dry root yield (t/ha)	Dry matter content (%)	Starch content (%)	Starch yield (t/ha)	Dry root yield (t/ha)	Dry matter content (%)	Starch content (%)	Starch yield (t/ha)	Dry root yield (t/ha)
90N-60P <sub>2</sub> O <sub>5</sub> -90K <sub>2</sub> O	39.07 <sup>ab</sup>	28.45 <sup>ab</sup>	9.89 <sup>abcde</sup>	16.50 <sup>cd</sup>	40.84 <sup>ab</sup>	30.38 <sup>ab</sup>	12.40 <sup>ab</sup>	18.80 <sup>abc</sup>	40.19 <sup>ab</sup>	30.20 <sup>ab</sup>	12.51 <sup>ab</sup>	18.57 <sup>abc</sup>
99N-66P <sub>2</sub> O <sub>5</sub> -99K <sub>2</sub> O	38.71 <sup>ab</sup>	28.87 <sup>ab</sup>	10.29 <sup>abcd</sup>	16.80 <sup>cd</sup>	41.19 <sup>ab</sup>	30.27 <sup>ab</sup>	12.21 <sup>ab</sup>	19.37 <sup>abc</sup>	39.20 <sup>ab</sup>	30.75 <sup>ab</sup>	12.81 <sup>ab</sup>	18.60 <sup>abc</sup>
108N-72P <sub>2</sub> O <sub>5</sub> -108K <sub>2</sub> O	39.50 <sup>ab</sup>	29.83 <sup>ab</sup>	11.34 <sup>abc</sup>	17.50 <sup>cd</sup>	40.51 <sup>ab</sup>	31.00 <sup>ab</sup>	12.59 <sup>ab</sup>	18.00 <sup>abc</sup>	41.58 <sup>ab</sup>	30.98 <sup>ab</sup>	13.72 <sup>ab</sup>	21.50 <sup>ab</sup>
117N-78P <sub>2</sub> O <sub>5</sub> -117K <sub>2</sub> O	39.55 <sup>ab</sup>	29.87 <sup>ab</sup>	11.77 <sup>abc</sup>	17.00 <sup>cd</sup>	41.24 <sup>ab</sup>	31.06 <sup>ab</sup>	12.91 <sup>ab</sup>	19.37 <sup>abc</sup>	43.12 <sup>ab</sup>	31.26 <sup>ab</sup>	14.04 <sup>ab</sup>	21.27 <sup>ab</sup>
No fertilizer	40.46 <sup>ab</sup>	27.89 <sup>ab</sup>	5.48 <sup>d</sup>	9.56 <sup>f</sup>	40.82 <sup>ab</sup>	28.95 <sup>ab</sup>	5.90 <sup>f</sup>	10.04 <sup>f</sup>	42.17 <sup>ab</sup>	29.89 <sup>ab</sup>	6.22 <sup>ef</sup>	11.74 <sup>ef</sup>
Farmers practice	40.45 <sup>ab</sup>	28.35 <sup>ab</sup>	7.56 <sup>def</sup>	12.43 <sup>ef</sup>	38.92 <sup>ab</sup>	30.89 <sup>ab</sup>	7.29 <sup>def</sup>	12.36 <sup>ef</sup>	40.86 <sup>ab</sup>	31.25 <sup>ab</sup>	7.40 <sup>def</sup>	14.76 <sup>ef</sup>

# Cost and profits analysis of cassava with different treatments of fertilizer and densities

Fertilizer level	15,625 plants/ha				12,500 plants/ha				10,000 plants/ha			
	Fresh root yield (t/ha)	Gross income (mill VND)	Production costs (mill. VND)	Net income (mill VND)	Fresh root yield (t/ha)	Gross income (mill VND)	Production costs (mill. VND)	Net income (mill VND)	Fresh root yield (t/ha)	Gross income (mill VND)	Production costs (mill. VND)	Net income (mill VND)
90N-60P <sub>2</sub> O <sub>5</sub> -90K <sub>2</sub> O	34.77	66.06	28.95	37.11	40.87	77.65	27.7	49.95	41.27	78.41	26.7	51.71
99N-66P <sub>2</sub> O <sub>5</sub> -99K <sub>2</sub> O	35.67	67.77	29.72	38.05	40.37	76.70	28.47	48.23	41.57	78.98	27.47	51.51
108N-72P <sub>2</sub> O <sub>5</sub> -108K <sub>2</sub> O	38	72.20	30.49	41.71	40.6	77.14	29.24	47.90	44.2	83.98	28.24	55.74
117N-78P <sub>2</sub> O <sub>5</sub> -117K <sub>2</sub> O	39.4	74.86	31.26	43.60	41.5	78.85	30.01	48.84	44.83	85.18	29.01	56.17
No fertilizer	19.65	37.34	21.23	16.11	20.44	38.84	20	18.84	20.81	39.54	19	20.34
Farmers practice	26.67	50.67	24.13	26.54	25.72	48.87	22.9	25.97	23.49	44.63	21.9	22.73

# Effect of density and fertilizer amount on soil physical and chemical factors (thickness 0-30cm)

Treatments	Monitored indicators				
	N <sub>15</sub> (%)	P <sub>2</sub> O <sub>5</sub> <sub>dt</sub>	K <sub>2</sub> O <sub>dt</sub>	Ca <sup>2+</sup>	Mg <sup>2+</sup>
		(mg/100g soil)	(mg/100g soil)	(dl/100g soil)	(dl/100g soil)
Before trials	0.12	2.49	8.38	0.73	0.09
90N-60P <sub>2</sub> O <sub>5</sub> -90K <sub>2</sub> O	0.1	1.38	8.45	0.44	0.08
99N-66P <sub>2</sub> O <sub>5</sub> -99K <sub>2</sub> O	0.11	1.46	13.47	0.44	0.09
108N-72P <sub>2</sub> O <sub>5</sub> -108K <sub>2</sub> O	0.11	1.29	10.69	0.44	0.08
117N-78P <sub>2</sub> O <sub>5</sub> -117K <sub>2</sub> O	0.13	1.54	9.28	0.5	0.08
No fertilizer	0.1	1.36	7.23	0.47	0.1
Farmers practice	0.11	1.14	8.24	0.52	0.08





# Present diseases and insects on cassava at project area

No	Pest, disease	Causes	Infected parts	Occurring time	Presentated rate
1	Leaf blight	<i>Xanthomonas axonopodis</i> pv. <i>Manihotis</i>	Leaf, stem, root, tuber	June – July	****
2	Brown spot	<i>Cercospora heningssi</i>	Leaf	June – July	****
3	Witches broom	<i>Phytoplasma</i>	Leaf, stem, root, tuber	May – June and strong development in Jan – March in following year	***
4	Anthraxnose	<i>Colletotrichum gloeosporioides</i> f. sp. <i>Manihotis</i>	Leaf, stem	June – July	***
5	CMD	<i>Cassava mosaic virus</i>	Leave	June	rare
6	Pink mealybug	<i>Phenacoccus manihoti</i>	Leaf, top	Whole season	*
7	Red mite	<i>Tetranychus urticae</i>	Leaf, stem	Dry season	**

# Red mite on high yield cassava variety in Eakar district



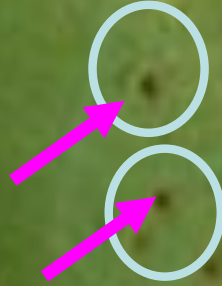


# Symptom of leaves





# Causal factors: Red mites





# Bacteria *Xanthomonas* on cassava



HL S11, and HL S10 infected



# Phytoplasma (which broom) on KM 94

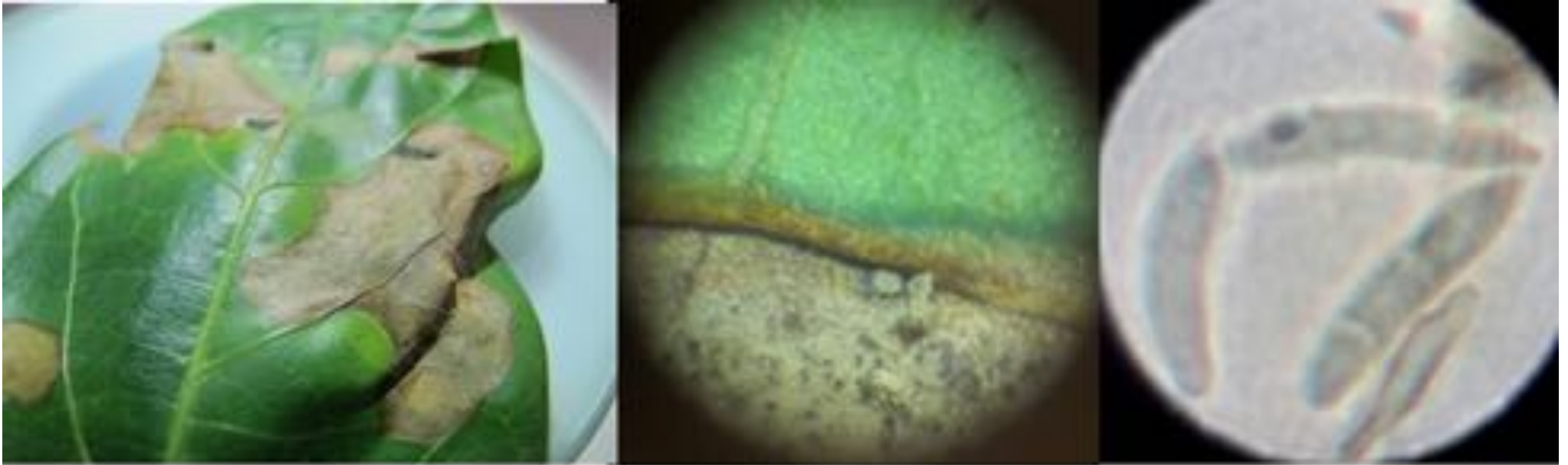




# CMV, rarely showed on cassava in Dak Lak



# Leaf spots, Cercospora





**Mealybug**



**Brown Mealybug**





**White fly**



**Worm**



**Pink mealybugs**



*Pest and disease prevalence monitored in evaluated varieties*

Varieties	Pest and disease prevalence (%)		
	Brown leaf spot	Witches broom disease	Pink mealybugs
KM94 (control)	20	16	10
KM140	15	13	12
KM505	15	11	11
KM419	8	5	6
HLS10	9	6	7
HLS11	10	7	8
RA YONG9	11	10	8



# Harvest field days

- Strong interest from participants in improved varieties evaluated in the trials.
- Questions from farmer participants were about
  - (i) how to get access new varieties and appropriate fertilizers
  - (ii) how to access to clean planting materials
  - (iii) how to identify and maintain planting materials clean for next season.





## **Stakeholders participated in Trials, training and the harvest field days**

1. Daklak Provincial Department of Agricultural and Rural Development
2. District agricultural officers and extension staff from 7 communes of Eakar and KrongBong
3. KrongBong and Eakar district leaders
4. Representatives from 7 cassava processing factories located in 5 districts of Daklak
5. Representative from 1 ethanol processing factory in Daknong province  
cassava traders in KrongBong district
6. 60 farmers from KrongBong district
7. farmers from Eakar district
8. students from TNU: undergraduated, Master and PhD. Can.

## Challenges and constraints

- Farmer's knowledge of sustainable cassava production techniques are limited
- Farmers were very interested in variety trials but not very interested in learning about cassava fertilizer trials in the harvest field days in Krong Bong district.
- Farmer's knowledge on pest and disease identification and management is very limited.

- Planting materials are currently shared between farmers
- KM94, the most popular variety which has been adopted widely for more than ten years is highly susceptible to witches broom disease and pink mealybugs
- Other improved varieties are not yet easily accessible by farmers.



# Future plans and partnerships, Opportunities and new ideas for 2018

## Opportunities

Interest from cassava processing factories in improved technology particularly in new potential varieties can provide a good opportunity for distribution of new varieties and dissemination of appropriate cassava management techniques.

- Strong interest from Daklak DARD in improvement of soil fertility of sandy Acrisol soil type is an opportunity to improve farmer's knowledge through the extension system which has network at village level.

## Future plans for policy engagement

- Organize a meeting with Daklak PPC and DARD to present research results from trials conducted this year along with policy recommendation.
- A follow-up meeting can be organized with processing factories and extension agencies, depending on the results of the meeting with PPC and DARD.

# Future plans for engagement with value chain stakeholders for adoption with the same partnership

## 1. New Varieties

Dissemination of new varieties in the value chain in Dak Lak

Linkages of Partners with the small trader/farmer group networks in Ea Kar and through linkages with farmers taking credit from the Krong Bong factory.

Set up variety selection by TNU

## 2. More effective fertiliser treatments.

Development and dissemination of more appropriate fertiliser formulation for cassava production together with fertiliser companies associated and networks of agricultural input supply shops.

Strong interest from Dak Lak DARD in improvement of soil fertility of sandy acrisol soil type is an opportunity to improve farmer's knowledge through the extension system which has network at village level.

## 3. Integrated pests managements: Survey, identification, causing and management

- Increasing capacity of TNU in research in cassava pests
- Training to farmers for pest managements

## 4. Cassava integrated managemnet

- Set up trials



# THANKS FOR YOUR ATTENTION

