Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

Establishing sustainable solution to cassava disease in mainland Southeast Asia

Agricultural Genetics Institute (AGI)

Mid-term review

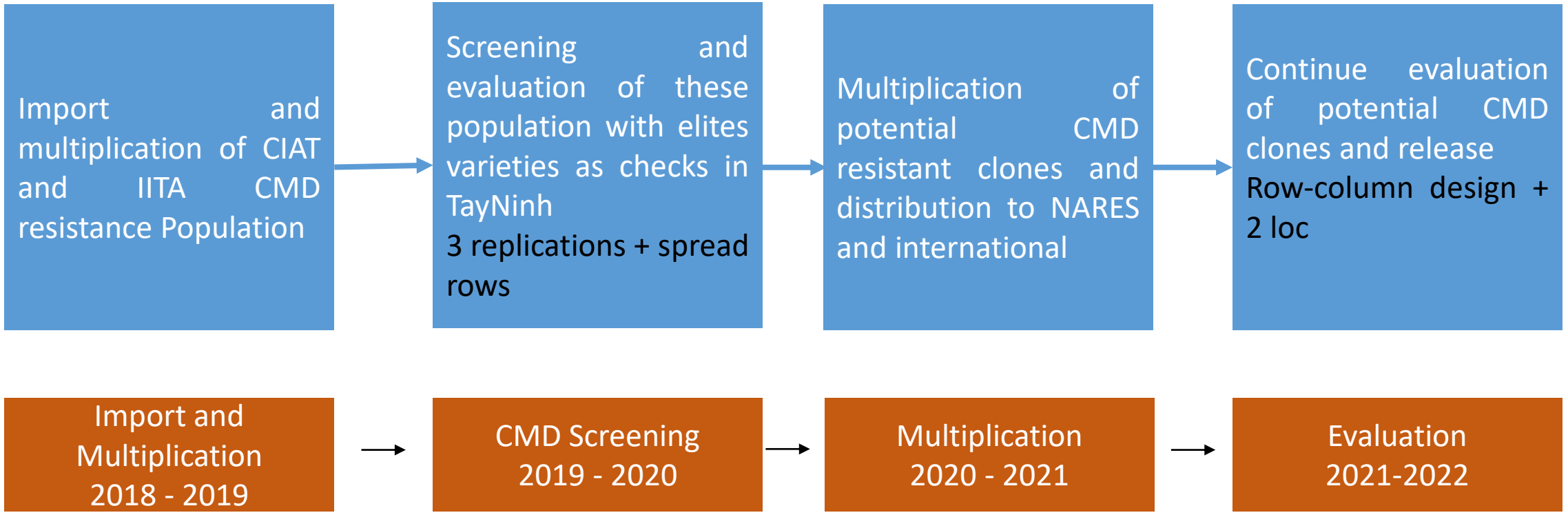
02/2022

Project Objective

- **Objective 2**: Enhance the **capacity** and collaboration between breeding programs in mainland Southeast Asia to develop new product profiles for commercially viable **cassava varieties** by identifying and incorporating known and novel sources of resistance to Cassava Mosaic Disease (CMD) and Cassava Witches Broom Disease (CWBD) into national breeding programs

- **Objective 4**: Develop and evaluate technically feasible and economically sustainable cassava **seed system models** for the rapid dissemination of new varieties and clean planting material to smallholder farmers in different production systems and value chains.

Timeline


Import and multiplication of CIAT and IITA CMD resistance Population
Screening and evaluation of these population with elites varieties as checks in TayNinh
3 replications + spread rows
Multiplication of potential CMD resistant clones and distribution to NARES and international
Continue evaluation of potential CMD clones and release
Row-column design + 2 loc
Import and Multiplication 2018 - 2019
CMD Screening 2019 - 2020
Multiplication 2020 - 2021
Evaluation 2021-2022

Import and Multiplication of CIAT and IITA CMD resistant clones`

- 5 CMD resistant clones from IITA
- 102 clones from CIAT.
- 10,000 plantlets were multiplied and ready for evaluation September 2019
- 330 clones from core collection, in total 509 clones 2020-2021

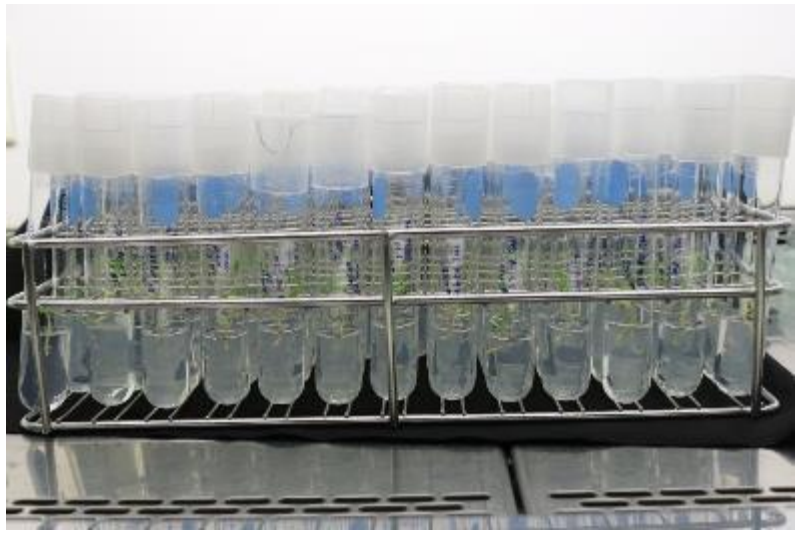
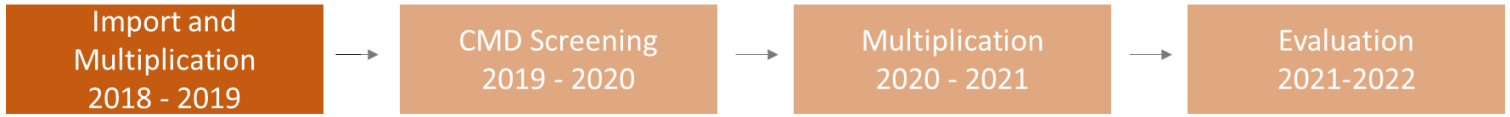
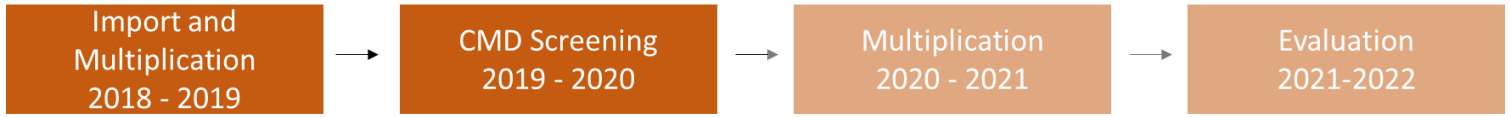


Figure 1. Multiplication of 107 clones using tissues culture



Screening and evaluation of these population with elite varieties as checks in TayNinh

Figure 2. Planting 107 clones for CMD evaluation



Screening and evaluation of these population with elite varieties as checks in TayNinh

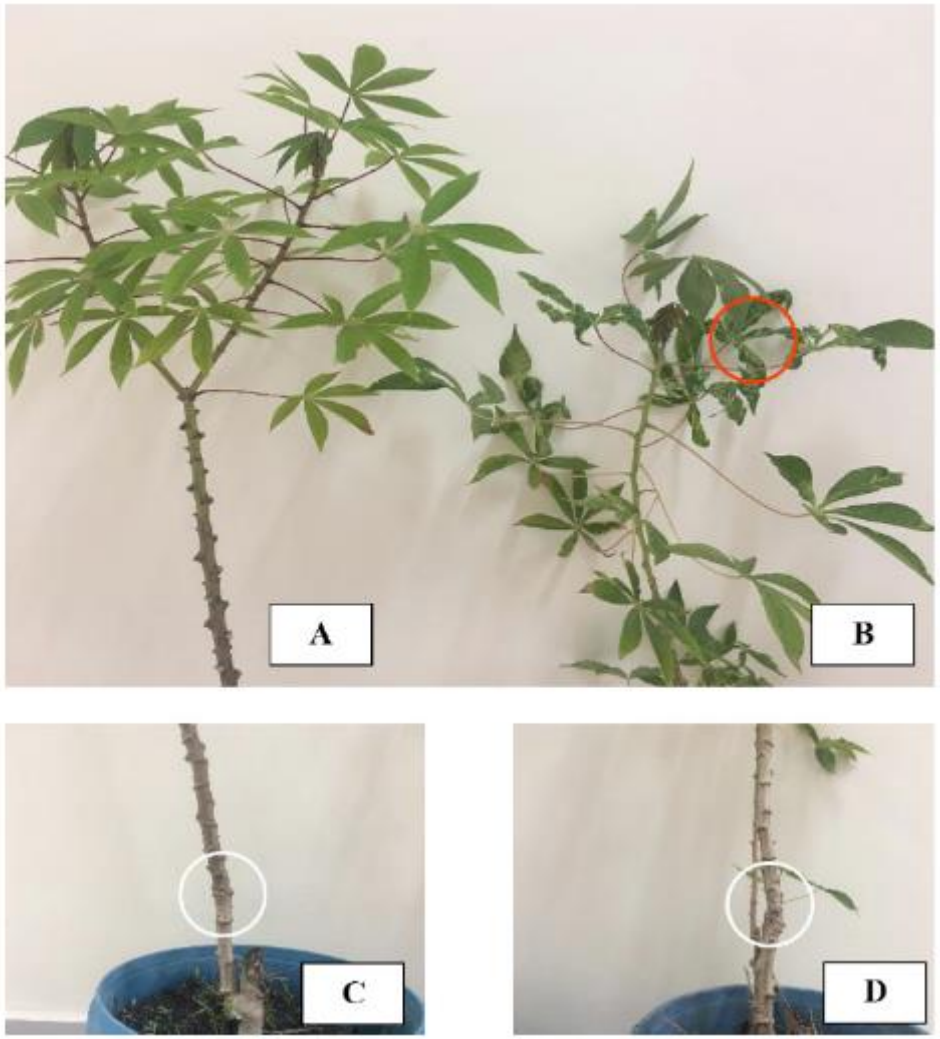


Figure 3. Results of grafting to quick assess resistance to CMD. A: C-33 grafts show no CMD symptoms; B: Clone 50C313 with CMD symptoms with mosaic leaf (red circle); C & D: Successful grafting (white circle).

42 clones are confirmed resistance after the screening

Figure 4. IITA-TMS-IBA980581 (HN5) resistant variety harvested after 11 months in Tan Chau, TayNinh (September 2020)

Figure 5. IITA-TMS-IBA972205 (HN3) resistant variety harvested after 11 months in Tan Chau, TayNinh (September 2020)

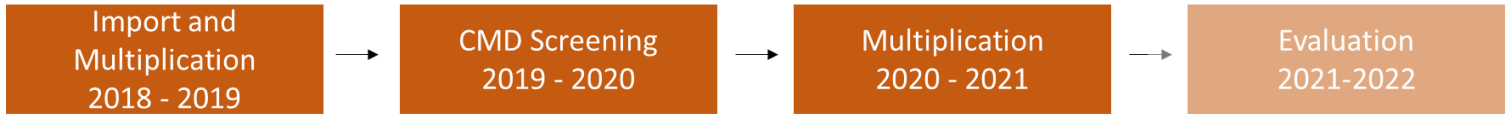
Multiplication of resistance CMD clones

After finished evaluation in late 2019, we determined 42 clones that can resistance to CMD.

We focus only to multiply the CMD resistance clones using tissue culture and traditional method.

Figure 6. Multiplication of 42 resistance clones using tissue culture in AGI

Figure 7. Multiplication of 42 resistance clones in Sonla province



Multiplication of potential CMD resistant clones and distribution to NARES and International partners (2020-2021)

No.	Countries	Varieties	Number of plants
A	International		1490
1	Laos	5 IITA CMD resistant clones	600
2	Cambodia	5 IITA CMD resistant clones	800
3	Sri Lanka	5 CIAT CMD resistant clones 13 CIAT elite clones	90
B	National		
1	HLARC	42 resistant clones	

Figure 8. Package of 500 plants

To national partners (HLARC) in 8/2020:
42 resistance clones

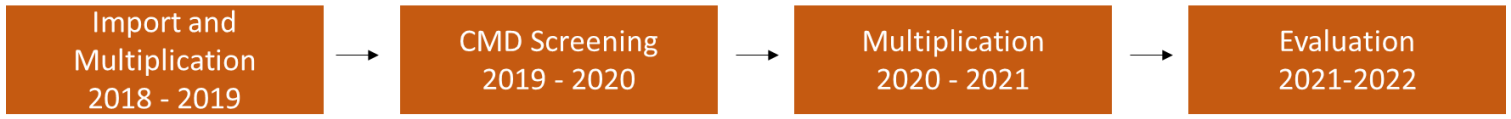
Develop protocols and enhance capacity of national programs for the safe and effective transfer of genetic material

Developed standard operating procedure (SOP) for the safe and effective transfer of genetic material in Vietnam.

Protocols for the safe and effective transfer of genetic material **Introduction** The guideline and protocol for The safe and effective transfer of genetic material were developed for the Project "**Establishing sustainable solutions to cassava diseases in mainland Southeast Asia**". Primary users of the protocols will be researchers/administration staff. Guidance and instructions will be provided for the design and implementation of activities that include contents described in Page 2. The protocols should be treated as a living document as they are subject to any changes for improvement. These documents are jointly developed in collaboration with Agriculture Genetics Institute (AGI) and International Center for Tropical Agriculture (CIAT). Prepare by Mr. LE Ngoc Tuan - AGI Date: 10 Oct 2020	**(Bản thảo) Các quy trình chuyển giao vật liệu an toàn và hiệu quả** **Giới thiệu chung** Các hướng dẫn và quy trình chuyển giao vật liệu an toàn và hiệu quả được phát triển trong khuôn khổ dự án **"Thiết lập các giải pháp bền vững cho bệnh sắn ở Đông Nam Á",** đây là dự án được tài trợ bởi CIAT, trong khoảng thời gian từ 2020-2023. Đối tượng chính sử dụng các quy trình này là các nghiên cứu viên hoặc cán bộ tổ chức hành chính. Về cơ bản, các thông tin của các quy trình này được sử dụng để thiết kế và tối ưu hoá các hoạt động được đề cập ở trang 2. Thông tin trong các quy trình này không mang tính cố định. Căn cứ trên hoạt động thực tế, các thông tin có thể được thay đổi để đảm bảo tính ứng dụng. Các quy trình này được xây dựng dựa trên sự hợp tác của các bên bao gồm: Viện Di truyền Nông nghiệp (AGI) và trung tâm Nông nghiệp Nhiệt đới Quốc tế (CIAT). Tác giả: Lê Ngọc Tuấn – Viện Di truyền Nông nghiệp Ngày: 10/10/2020

Continue evaluation of potential CMD clones for release

- Yield Trials of 42 clones established in Tay Ninh in 2020.
- Yield trial established in Son La in 2021 – 9 clones.
- Yield trials in Tay Ninh 2021 – 12 clones.
- Demonstration at larger areas of HN3 and HN5 clones in Thanh Hoa, Gia Lai, Kon Tum, Quang Ngai and Quang Tri and Dong Nai.



Yield trials of 42 CMD resistant clones in May 2020

Name CODE	Genotype	Plant Type TN	Main stem height TN	First branching height TN	Germination rate (%) TN	Yield TN	Starch TN	Observations
C42	AR35-1	3	293	213	0.98	28.85	27.62	
C48	AR42-4	3	330	263	1.00	21.58	27.52	
C97	**AR9-48**	**4**	**294**	**258**	**0.92**	**24.48**	**26.30**	
C74	CR13-8	3	315	167	0.93	27.45	29.73	
C36	**CR24-16**	**4**	**287**	**287**	**1.00**	**29.03**	**30.38**	
C21	CR25-4	4	303	273	0.98	23.58	30.07	
C80	**CR27-20**	**3**	**217**	**137**	**0.95**	**23.95**	**30.66**	
HN3	**IITA-TMS-IBA972205**	**1**	**300**	**134**	**0.87**	**18.40**	**25.50**	
HN5	**IITA-TMS-IBA980581**	**4**	**318**	**181**	**0.97**	**31.10**	**27.95**	
HN1	**TMEB419**	**4**	**285**	**272**	**0.90**	**42.55**	**29.37**	
KM140		4	191	191	1.00	17.28	27.28	Lodging in Tay Ninh
KM94		4	247	247	1.00	7.61	29.25	Stunting
KM419		4	159	151	1.00	4.03	28.70	
KM505		4	233	227	0.77	8.85	29.40	Stunting, lodging, small roots

Advanced yield trials of 12 clones in April 2021

- 2nd yield trial of 12 clones selected from the yield trial in 2020 established in April 2021 in Tay Ninh with Row column design (4 rows, 12 columns and 3 reps). The density is 10,000 plant/ha. Harvested is in 19th February 2022.

Figure 9. Roots from left to right IITA-TMS-IBA980581, CR27-20, TMEB419, CR24-16, IITA-TMS-IBA972205 with starch content 22.5%, 28.8%, 27.3%, 29.7% and 25.6%, respectively – at 10 month age (Feb -2022)

- IBA980581 and IBA972205 are released by AGI in March and July 2021.
- Of these varieties, TMEB419 is co-released as HN1 with HLARC. CR24-16, CR27-20 and AR9-48 are co-released with CIAT as HN36, HN80 and HN97 in December 2021- January 2022.

Advanced yield trials of 12 clones in April 2021

- Two potential clones from CIAT

Figure 10. Roots from left to right CR25-4, CR52A-4– at 10 month (Feb -2022)

Participatory evaluation with cassava stakeholders

Figure 11. The representative of the delegation of the Plant Protection Department coordinated with the Plant Production Department, National Center for Agricultural Extension, Agricultural Genetics Institute, Plant Protection Institute; Department of Agriculture and Rural Development, Sub-Department of Plant Production and Plant Protection, Agricultural Extension Center of Tay Ninh Province to evaluate new clones (11/2021)

Breeding

- Established crossing nurseries in Son La in 2019-2020 and 2020-2021
- Flower inducing technology with red-lights introduced by CIAT are mobilized in to the nursery
  - Identified good flowering genotypes: AR42-4 (C48), AR9-48 (HN97) , CR27-20(HN80), CR52A-4 (C83), HN3, HN5, Rayong 11, KM94, KM419
  - In 2020-2021 we collected 12,000 half-sibs seeds from 14 parents
  - We only could harvest 50 full-sibs seeds because we missed the best crossing time due to travel restrictions due to COVID lockdown.

Test flower inducing technology in Northern Vietnam by comparing with normal crossing nurseries

Establish crossing nursery with CMD resistance clones and elite clones in Sonla province

Figure 12. Flowering and crossing in Sonla province

Half-sibs seeds

Figure 13. Drying seed

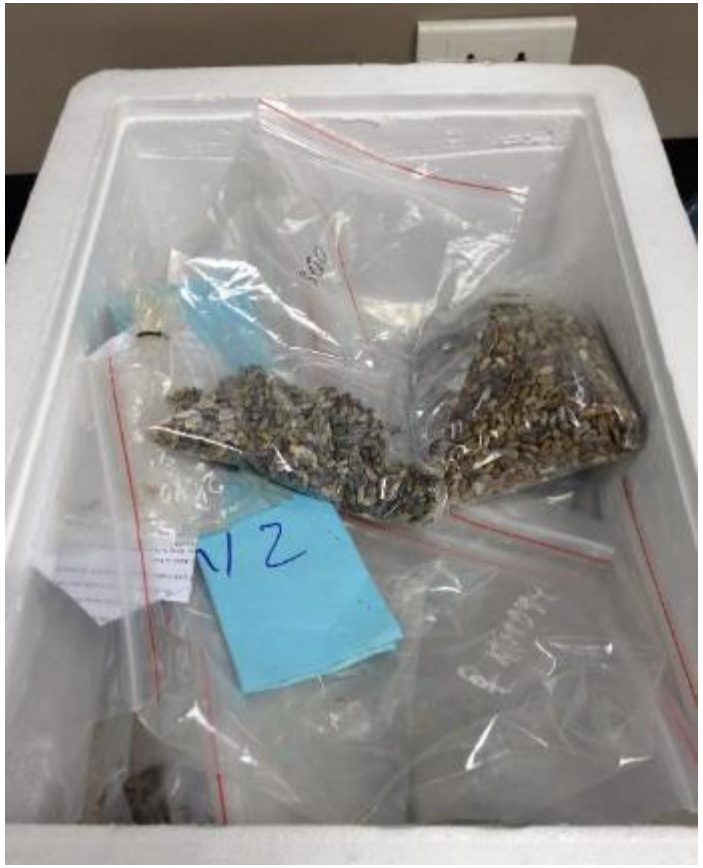


Figure 14. Package of drying seed

We collected nearly 12,000 seeds from poly crossing.

Objective 4

Scaling out released CMD varieties

- In collaboration with private sector
  - Seeds and roots traders
  - Cassava starch processing factories
- In collaboration with national agricultural administrative agencies
  - Extension centers
  - Plant protection sub-departments
  - Breeds and Crops Center

Actively engaged by seeds trader

Seed traders participate from evaluation of potential genotypes and then distribute

Figure 15. Introduce new variety for trader (person with white hat) and plant protection officer

Engagement with national agricultural extension centers, crops and breeds centers and plant protection sub-departments

- Transferring 2 registered varieties: IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) to different climate condition for double check CMD resistance and growth and development in these regions.

Table 1. 5 regions have 2 new registered varieties for demonstration

No	Region	Ha
A	**Northwest**	**0.2**
	Son La province	0.2
B	**North Central**	**0.6**
	Thanh Hoa province	0.3
	Quang Tri province	0.3
C	**South Central Coast**	**0.2**
	Quang Ngai province	0.2
D	**Central Highlands**	**0.3**
	Gia Lai province	0.3
E	**Southeast**	**10**
	Dong Nai province	2
	Tay Ninh province	8
	Total	**11.3**

Collaborating with Agricultural Extension Center of Tay Ninh Province

- Planting 12.5 ha IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) in the end of 2021. In plan, this area will provide at least 120 ha for next year to this province. It is starting in December 2021.

IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) distributed to Quang Ngai and Gia Lai

Figure 16. Transferring 2 registered varieties to Quang Ngai and Gia Lai

Figure 17. IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) in Sathay, Kontum (Central Highland)

Figure 18. IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) in SonTinh, Quangngai (South Central Coast)

Figure 19. IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) in SuoiDay, Tayninh (Southern Central Region)

CMD Resistant adoptability so far

- IITA-TMS-IBA972205 (HN3) and IITA-TMS-IBA980581 (HN5) are now evaluated and adopted in 5 different agro-ecological of Vietnam.
- CR24-16 (HN36), CR27-20 (HN80), AR9-48 (HN97) and TMEB419 (HN1) are available in Tay Ninh with very
- High demand of CMD resistant clones from private sector namely IITA-TMS-IBA972205 (HN3) , IITA-TMS-IBA980581 (HN5) , TMEB419 (HN1) and CR24-16 (HN36).

Clean seeds distribution for tunnel systems

- Clean seeds of potential CMD resistance clones established for distribution to tunnels in other region of Vietnam when required.
- TMEB419 (HN1), IITA-TMS-IBA920057 (HN2) mother plant are distributed to tunnels in Daklak by the end of February 2022.

Figure 20. Mother plant for tunnel system in HungYen

Rapid multiplication with tunnel system

- Test Rapid multiplication by tunnel system in the North of Vietnam in 3 months after planting without fertilizer.

	Number of mother stem	Number of 3 nodes cuttings	Platnting date	Number of cutting in 24-Nov	Cutting in 16-Dec	Cutting in 25-Jan	Total cuttings	Survival cuttings	Rooting rate	Multiplication rate
AR9-48	10	69	12- Oct	45	26	50	121	109	90	10.9
TMEB419	10	110	12- Oct	45	187	216	448	403	90	40.3
CR24-16	10	154	12- Oct	45	238	353	636	572	89	57.2
Total	**30**	**323**					**1205**	**1084**		**36.3**

Test Rapid multiplication by tunnel system in the North of Vietnam

- Adaption and testing tunnel system for propagation in AGI

Figure 21. Tunnel system. From left to right: After planting 1 week, after planting 4 weeks, after plating 5 weeks and experiment to cut after 5 weeks

Test Rapid multiplication by tunnel system in the North of Vietnam

- Adaption and testing tunnel system for propagation in AGI

Figure 22. Cutting from tunnel system. From left to right: in white and blue tray, 4 weeks after multiplied, black tray is plants cutting from 5 weeks-mother plant

Highlights

Objective 2

- Resistant clones **store tissue culture**.
- SOP for **safely transfer martial** developed and shared with partners.
- **1400 plantlets** of 5 IITA clones have been delivered to Laos and Cambodia. Elites CIAT and CMD CIAT genotypes have been distributed to Srilanka.
- **Six CMD resistant varieties** are official released.
- **Crossing nursery established** and 10,000 half-sibs seeds harvested

Objective 4

- **30 ha of HN3 and HN5** are distributed to partners in 5 different agro-ecological of Vietnam for evaluation and then distribution.
- Rapid multiplication with **tunnel system** tested under the North of Vietnam.

Lessons learnt

- Indication of CMD resistance clones are not available for farmers resulting it deception by traders.
- Farmers' knowledge in cassava farming practices are very different between regions. Farmer's knowledge in the North and the Central region are limited while much higher in Tay Ninh.
- Observations of new emerging diseases in long-term consecutively intensively cassava farming areas especially under abnormal weather condition (found from few plants in the field in Tay Ninh in January 2022).
- Need to identify the pest and disease-resistance profiles of CMD resistant genotypes
- CMD was found in Vietnam under very limited areas in 2017 but spread out very fast due to limited knowledge of stakeholders on CMD.

Planning activities for the remainder of project

Following activities for remainder of the project

Objective 2

- Focus on improving **breeding capacity**: Crossing activities in Son La and newly establishment of crossing nursery in Da Lat;
- **Tentative evaluation of 3,000 F1** collected from nursery in 2020-2021 under Tay Ninh's environment

Objective 4

- **Nationally promote resistant varieties** that have been released together with cultivation procedures suitable to each location, focus on Central Highland, Southern Central Region and South Central Coast.
  - Regional yield trials
  - Fertilizer and density trials of 6 recent released CMD resistant varieties in Tay Ninh: Planting in March 2022 – harvest January 2023
- Finalize cassava **rapid multiplication** procedures by tunnel system for Vietnam
- Promote and transfer **tunnel system** technology to cassava stakeholders.
- **Strengthening and scaling network** with seed traders and factory for widely distribution of CMD resistant genotypes.

Research and development proposes

Early diagnostic of newly emerging diseases in Tay Ninh to identify causes and find solutions for prevention and limit outbreak.
- Farming practices
- Breeding resistant varieties

A research in order to understanding soil fertility of cassava fields in TayNinh and develop solutions to improve **soil fertility** via improvement of adoption of sustainable cassava farming practices especially mobilize organic matters.

Develop **MAS tools** for early selection critical traits of cassava including disease resistance of CBB, CWBD, CBSD; DMC and if possible branching level in order to shorten breeding and evaluation cycles and associated costs.

THANK YOU FOR LISTENING