ENSURING A SUSTAINABLE TROPICAL FRUIT INDUSTRY IN THE MIDST OF CLIMATE CHANGE: THE VIETNAM STORY




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GENERAL INTRODUCTION

- Vietnam has very diversified climate condition to produce different fruit crops; we have temperate fruits, tropical fruits and sub-tropical fruits. The leading kinds of fruits in Vietnam including longan, lychee, banana, pineapple, citrus, dragon fruit, mango, rambutan, durian …

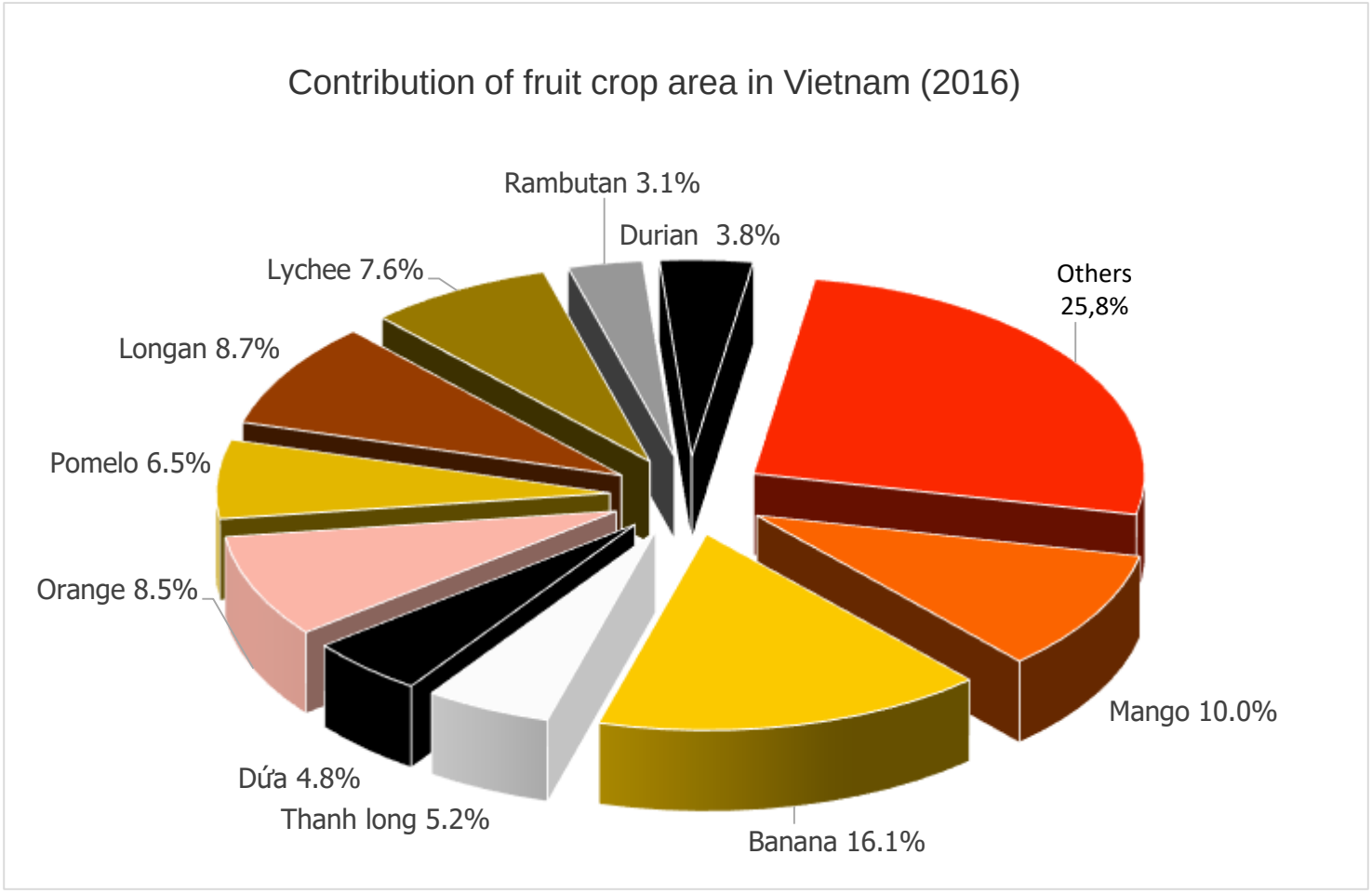
- There are over 848 thousand ha of fruit trees in Vietnam. Vietnam's fruit and vegetable export values have increased rapidly in recent years, reaching $ 2.45 billion in 2016.

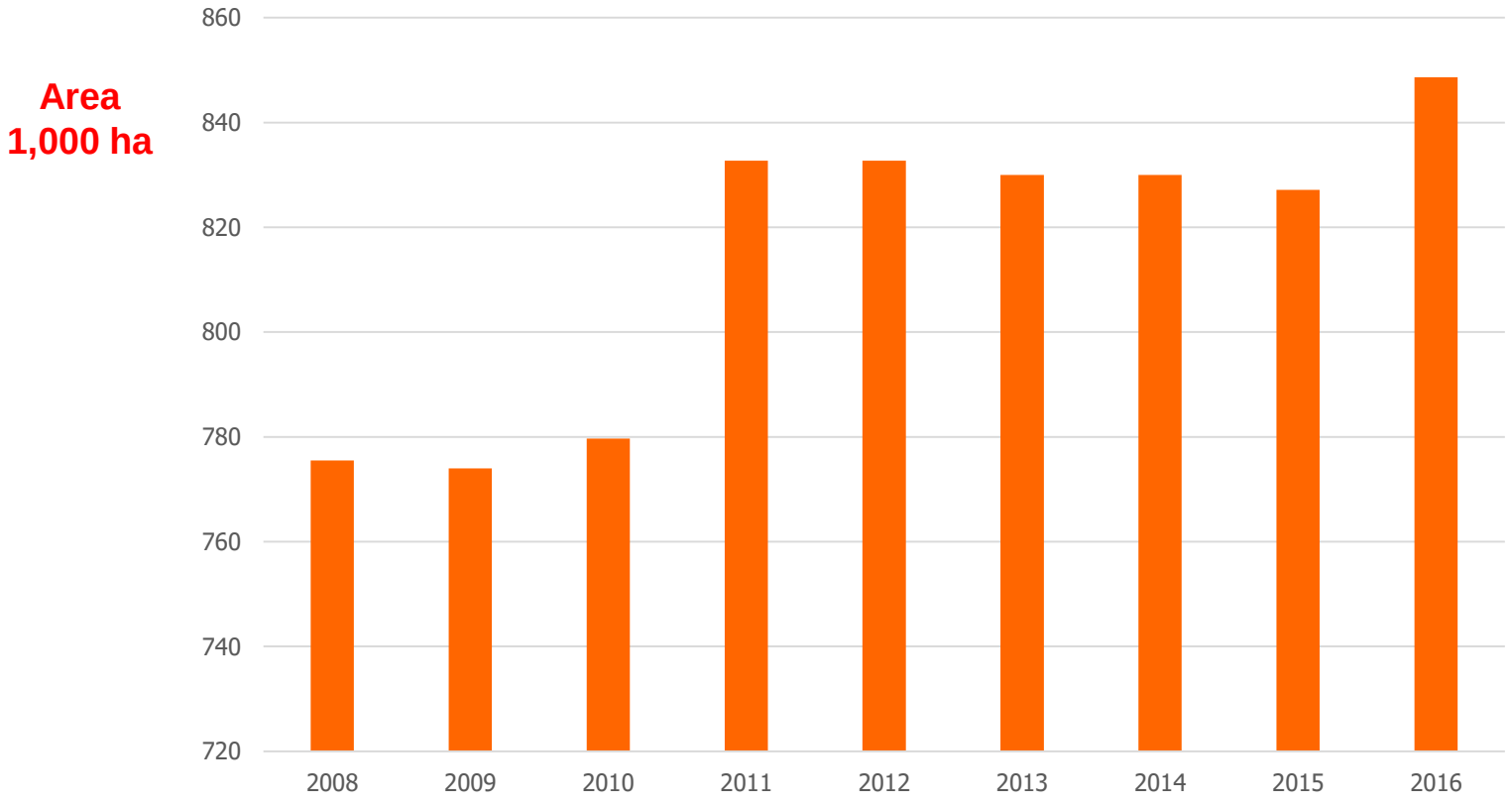
- Vietnam is one of the countries that suffers the most from climate change. Floods and droughts frequently occur in northern and central provinces, and in the Central Highlands. The area of fruit trees has rapidly increased in the Mekong River Delta.

Current status of fruit production in Vietnam, 2016

No	Kind of Fruits	Total area (1,000 ha)	Yield (ton/ha)	Production (1,000 tonnes)
1	Banana	136.48	16.2	1,968.71
2	Mango	84.77	9.4	707.89
3	Dragon fruit	44.00	22.8	817.80
4	Pineapple	40.91	16.3	579.98
5	Orange	72.08	12.4	594.78
6	Pomelo	54.75	11.7	474.54
7	Longan	73.94	7.8	504.99
8	Lychee	64.19	5.0	312.56
9	Rambutan	26.01	14.9	343.71
10	Durian	32.30	14.5	336.90
11	Others	219.21	-	> 1,300.00
	Total	848.64		> 8,000.00

Area percentage of fruit in total fruit area in Vietnam

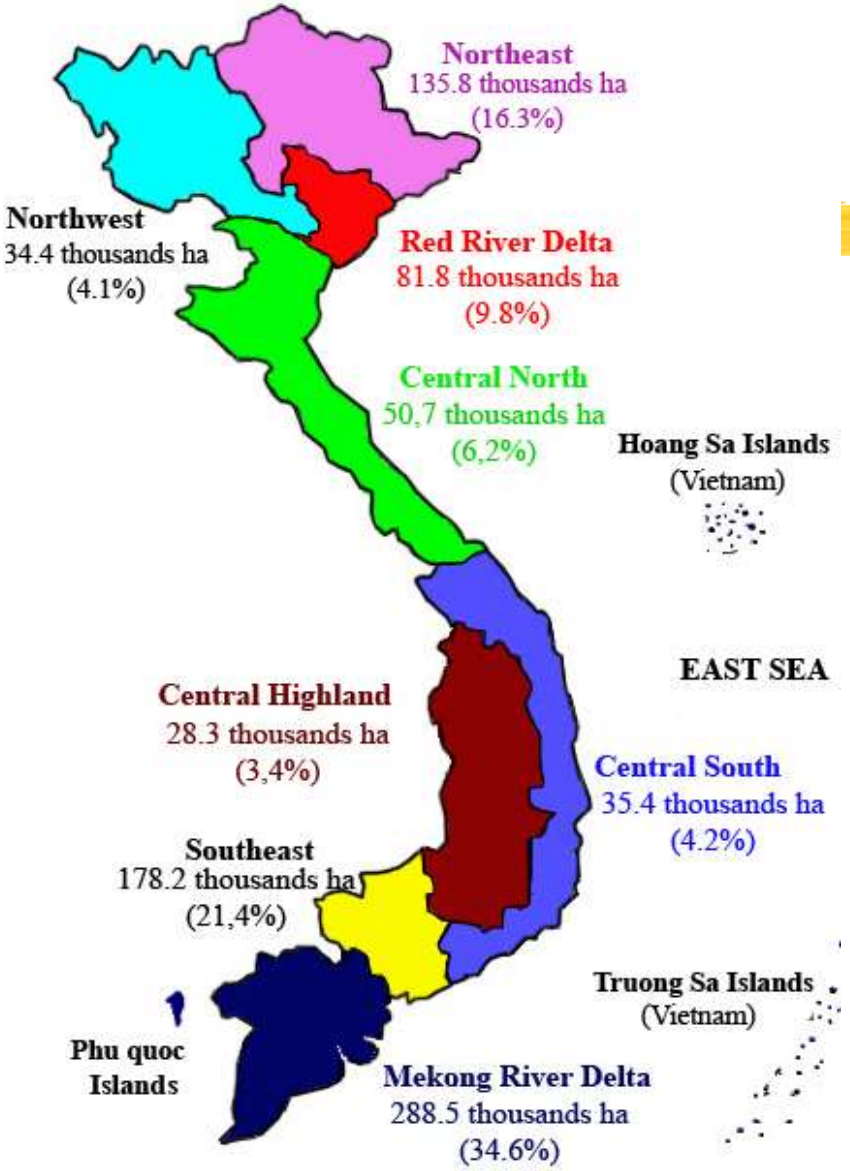




Growth of fruit tree area in Vietnam (2008 - 2016)

Fruit tree area by ecological regions in Vietnam

No.	Ecological regions	Fruit tree area (1,000 ha)	Contribution (%)
1	Northwest region	170,20	20,43
2	Red River Delta	81,80	9,82
3	Central Coast	50,60	6,07
4	South Central Coast	35,50	4,26
5	Central Highland	28,30	3,39
6	Southeast region	178,20	21,40
7	Mekong River Delta	304,20	35,84
	Total	848,60	100,00



Vietnam Fruit Production: 832,720 ha

Source: MARD, 2013

1. **North: citrus, banana, pineapple, mango, plum, peach, pear, persimmon, lychee, longan**
2. **Red River Delta:citrus, banana, pineapple, longan**
3. **Central North: citrus, banana, pineapple, mango, avocado**
4. **Central South: mango, dragon fruit, grape, jujube**
5. **Central Highland: avocado, durian, jackfruit, banana**
6. **Southeast: citrus, durian, rambutan, annona**
7. **Mekong River Delta: citrus, mango, pineapple, banana, durian, mangosteen, rambutan, longan**

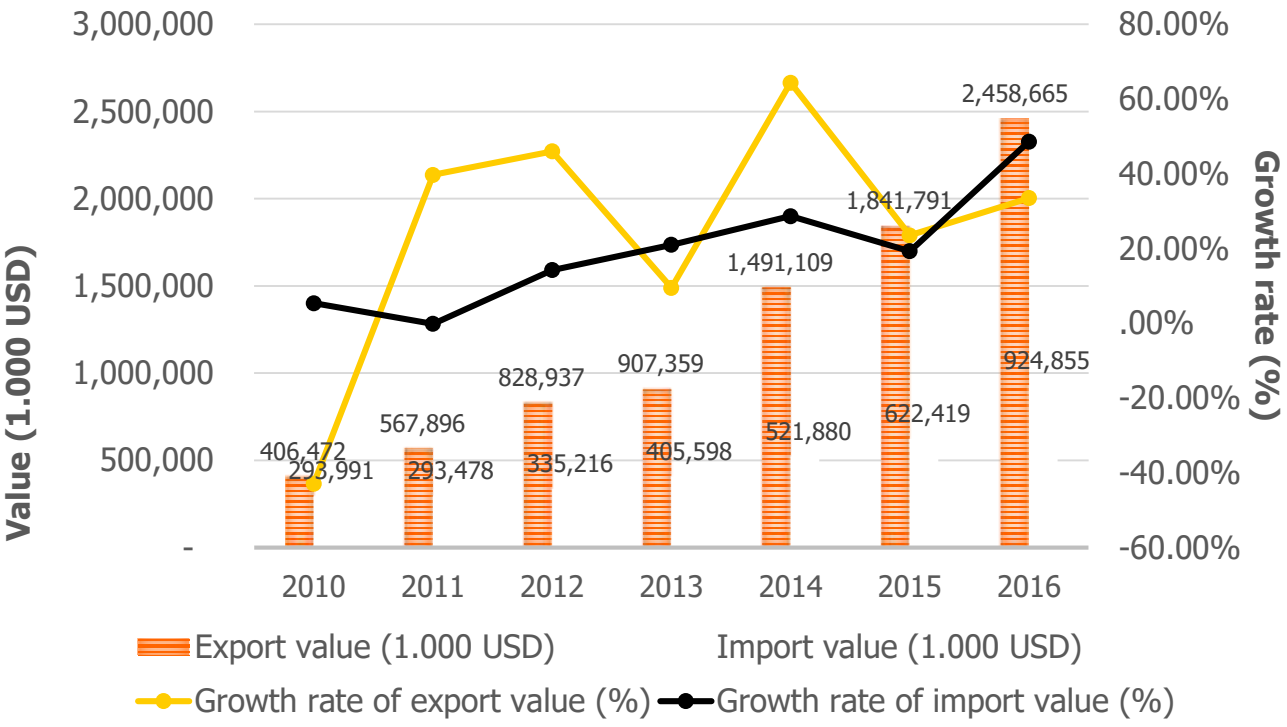
VIETNAM'S FRUIT AND VEGETABLE EXPORT

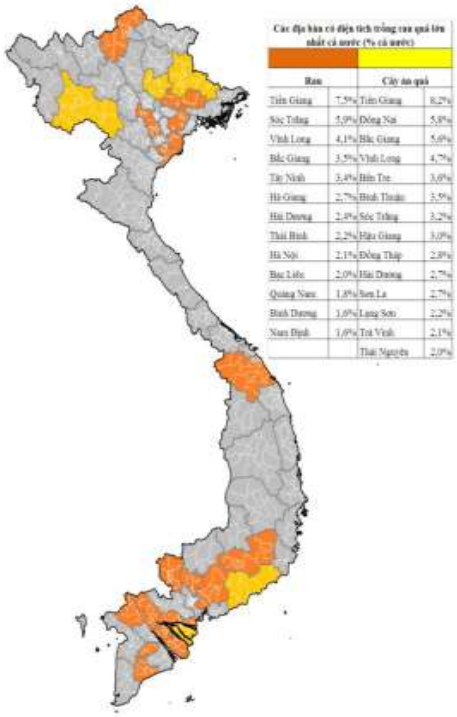
- Export turnover of fruits, vegetables and flowers increased from USD 23.1 million in 2000 to USD 471 million in 2010; in 2015: USD 1.85 billion and in 2016: USD 2.45 billion.

- Dragon fruit is the major export fruit in Vietnam. The export turnover of dragon fruit in 2010 reached USD 59 million, USD 483.4 million in 2015 and USD 800 million in 2016.

- In addition to dragon fruit, Vietnam export fruits such as mango, banana, pineapple, pomelo, longan, litchi and rambutan.

Overview of Vietnam's vegetable and fruit trade in 2016





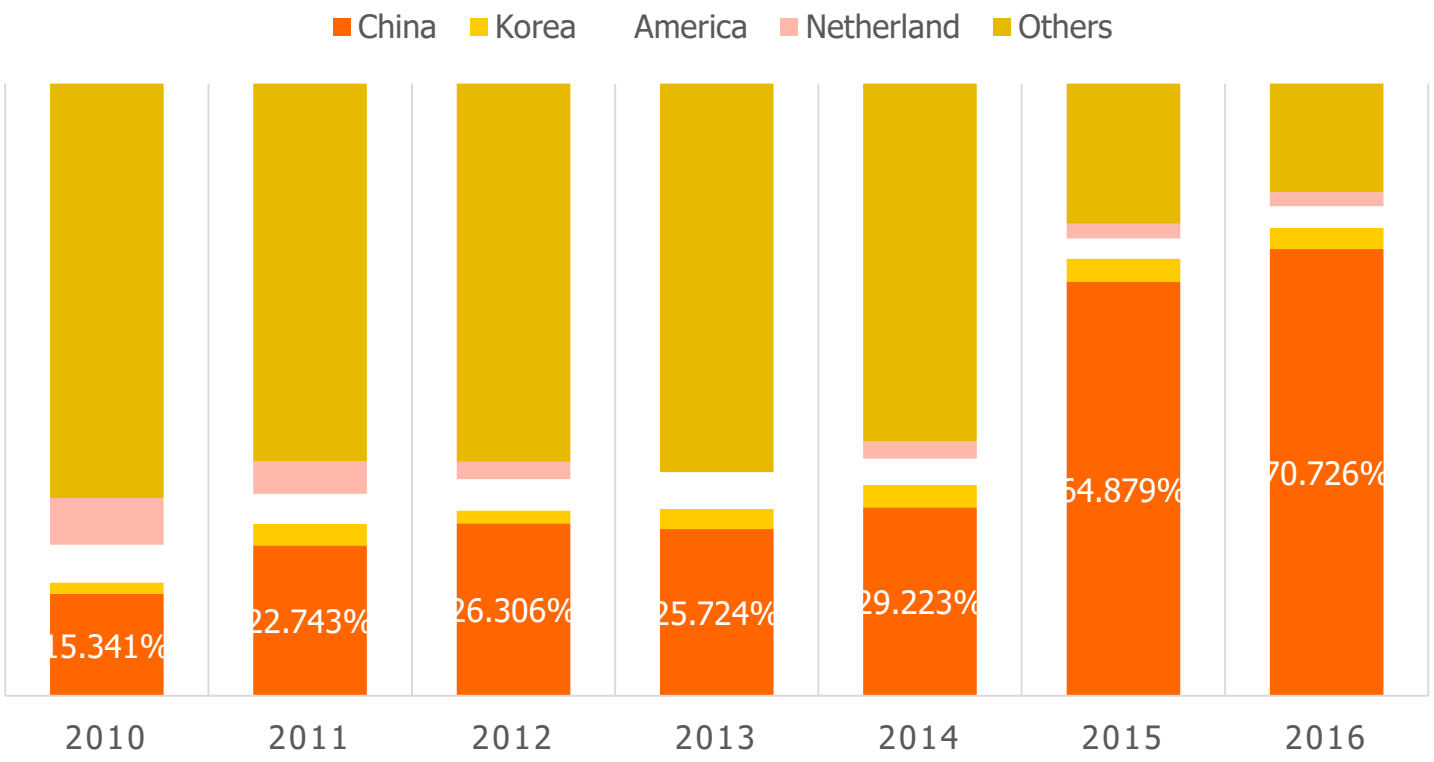
Source: MARD, 2017

Export value of major fruits in Vietnam

Unit: million USD

No	Fruit	Export value in 2010	Export value in 2016
1	Dragon fruit	59.00	800.00
2	Banana	1.10	45.20
3	Mango	0.46	35.43
4	Pineapple	0.82	0.22
5	Orange	0.015	0.043
6	Pomelo	1.48	1.35
7	Lychee	0.60	52.10
8	Longan	8.10	115.60
9	Rambutan	0.64	13.70
10	Durian	0.09	111.7

Major export destinations of Vietnam's fruit



Source: General Department of Vietnam Customs, 2016

Major export destinations of Vietnam's fruit

Destinations	Export value (million USD)
China	435.74
Japan	75.03
USA	60.74
Korea	57.03
The Netherlands	39.42
Russia	37.10
Taiwan	35.13

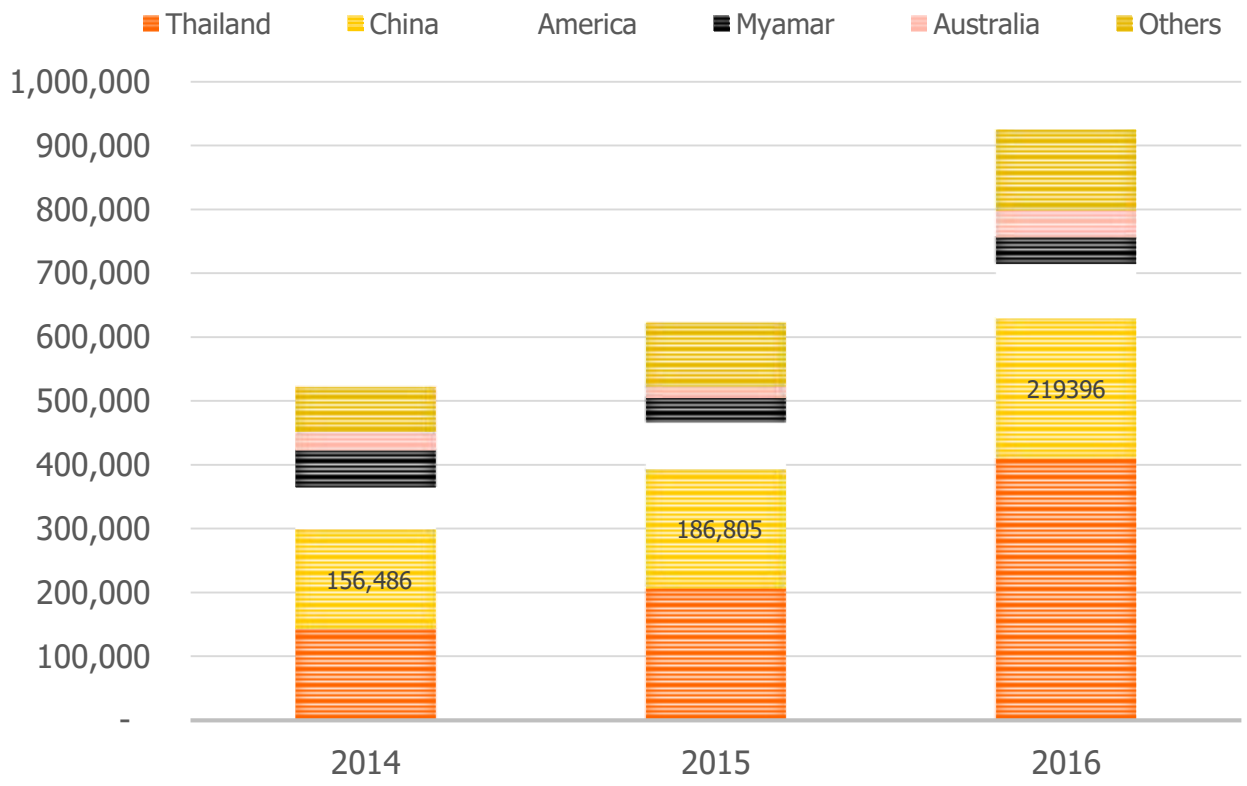
Source: General Department of Vietnam Customs, 2014

VIETNAM'S FRUIT AND VEGETABLE IMPORT

- Vietnam mainly imports grape, apple, pear, peach and tangerine from China (largest proportion); durian, mango, mangosteen and star apple from Thailand; grape and apple from USD; kiwifruit and apple from New Zealand.

- Import turnover of fruit and vegetable has increased continuously in recent years, however, only approximately 30% of the export value. Import turnover in 2016 was USD 925 million.

Major import markets of fruit and vegetables



Source: General Department of Vietnam Customs, 2016

Da xanh
pomelo variety



Ri6 durian variety

Cat Hoa Loc mango variety

SITUATION OF DROUGH AND FLOODING IN NORTHERN AND CENTRAL PROVINCES

- Long rainy season, heavy rains and storms occur at a much higher frequency than many years ago.

- Long lasting dryness causes severe drought in the central and central highland provinces.

- Diseases occurring in fruit growing areas are more concentrated and cause greater damage to production.

Flooding in the northern and central provinces

Drough in the central and central highland provinces

Diseases occur in concentrated banana growing areas

DROUGHT AND SALINITY INTRUSION IN SOUTHERN VIETNAM

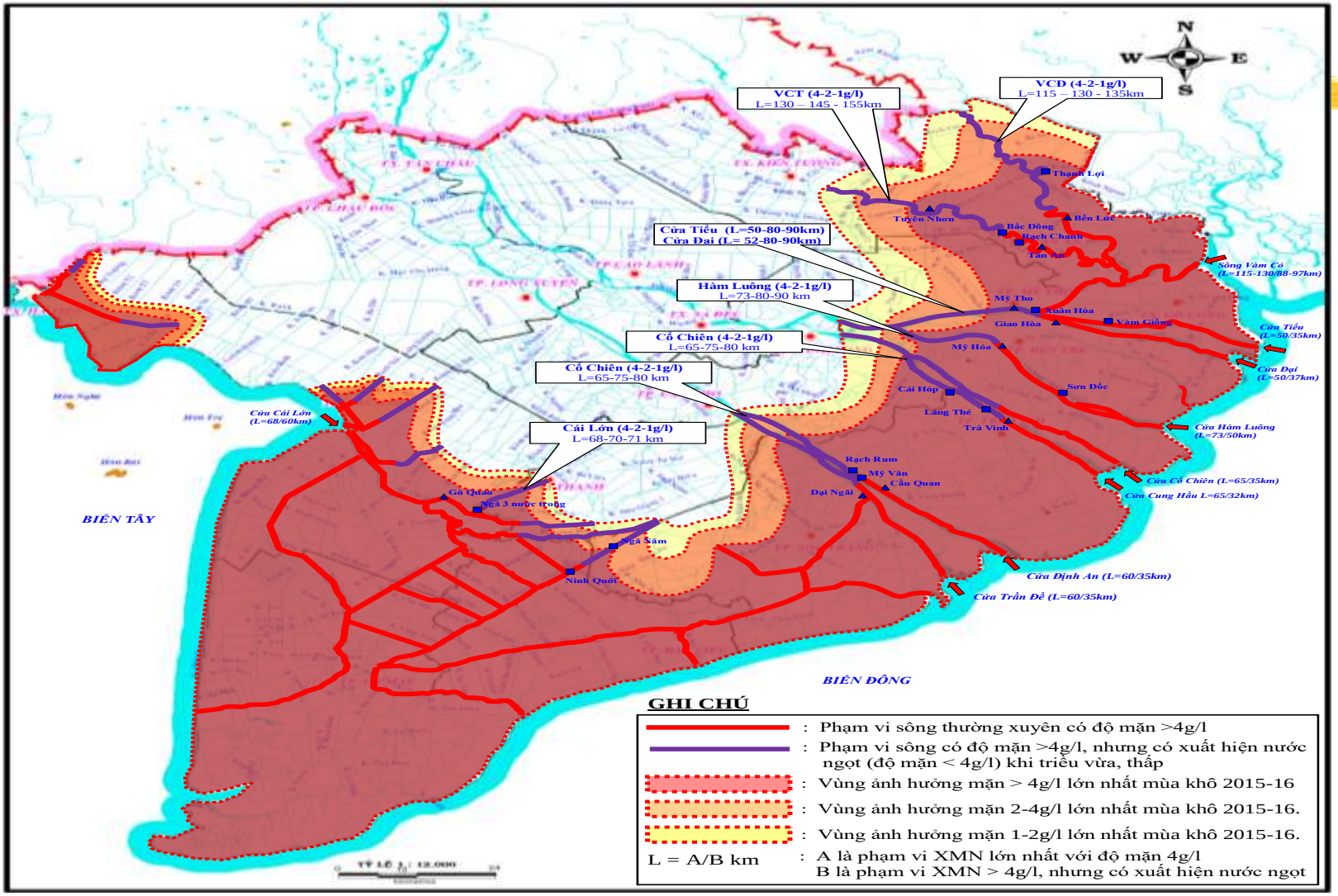
- Salinity intrusion in the Mekong River Delta and drought in the Southeast provinces has caused severe damage to agricultural production in general and fruit production in particular.

- Long term drought in many areas in the Southeast region resulted in lack of irrigation water, seriously affecting the growth, development and productivity of many fruit types.

- Salinity intrusion to fruit producing areas is mainly found in provinces of Ben Tre, Vinh Long, Tien Giang, Tra Vinh, Hau Giang, Soc Trang, etc affecting more than 10,000 ha of fruit production.

Mekong Delta, Vietnam. Source: NASA

Situation of saline intrusion in the Mekong Delta in 2016



Source:Southern Institute of Water Resources Research, 2016)

FRUIT ORCHARD SUFFERING FROM DROUGHT AND SALINITY INTRUSION

Rambutan (Tra Vinh), pomelo (Ben Tre) suffering from drought and salinity intrusion

Leaf falling on durian due to saline irrigation water

Durian not affected by saline water

Durian (Tien Giang province) suffering salinization and drought and root rot (Fusariium, Phytopthora and nematodes)

Salt tolerance of fruit trees in the Mekong River Delta

1. Group 1: Sensitive to salt (tolerant to salt concentration <1‰):

Avocado, banana, star fruit, longan, papaya, passion fruit, durian, rambutan, mango, mangosteen, strawberry.

2. Group 2: Moderately sensitive (tolerant to salt conc. from 1‰ - 2‰):

Cherry, citrus, guava, pineapple, star apple.

3. Group 3: Moderately tolerant (tolerant to salt conc. from 3‰ - 4‰):

Jackfruit, mango, soursop, custard.

4. Group 4: Tolerant (tolerant to salt conc. from 5‰ - 6‰):

Coconut, sapoche, tamarine, grapes (depending on varieties)

SOLUTIONS TO REDUCING LOSS DUE TO DROUGHT AND SALINE INTRUSION

- Strengthen orchards' dyke systems for prevention of saline intrusion
- Store fresh water in ditches or cement reservoirs / thick plastic bags for irrigation
- Avoid irrigating saline water to crops when its salt concentration is > 2 ‰.
- Avoid using saline water of which the salt concentration is > 1% for salinity sensitive fruit trees (group 1)

- In order to reduce evaporation and water needs of the tree, conduct pruning (shoots, flowers and fruit) regularly.

- Moisturise and maintain soil moisture by covering the soil with coconut leaves, straw ...

- Do not apply fertilizers containing Na^+ and Cl^- for it is toxic to the trees.

- Increase application of organic and potassium fertilizers to improve plants tolerance.

- Apply burnt lime (CaO) to the soil of alum and saline intrusion to remove salt and reduce acidity in the soil.

Recovery of durian orchard from saline intrusion in the Mekong River Delta

- Durian is sensitive to salinity that heavy losses in plant growth and development and yield have been recorded.

- The study was conducted on 18-year-old durian trees (var. Ri6) which were affected by saline intrusion, remaining > 50% of the leaves and <50% of the leaves were burnt.

- Fertilizers used: Rootwell (N: P: K, micronutrients and 20 amino acids), Rhizomyx (mycorrhizae)

- Foliar fertilizers used: Vitazyme (Brassinosteroids and Triacontanol), DS Gold (P, K and Humic + Fulvic), Silimax (N, K, Ca and Si).


BIO AGPPS
PHÂN BÓN LÁ HỮU CƠ SINH HỌC
GAPFARM
DS GOLD
NEW
DƯỠNG CHẤT CHO CÂY
ĐINH DƯỠNG CHO ĐẤT
100g


BIO AGPPS
PHÂN BÓN LÁ HỮU CƠ CAO CẤP
ROOTWELL
CHUYÊN DÙNG TƯỚI GỐC
TĂNG CƯỜNG CHO RỄ
5 Lít

Results:

After 2 months of implementation, the study showed that durian trees that were applied with bio-organic fertilizers recovered faster through the following criteria:

- Root recovery of durian trees was faster and stronger than that in the control.
- The number of shoots growing from leaf axillary was higher than that in the control.
- The length of shoots emerged from leaf axillary was greater than that in the control.
- Leaves were greener in color (by means of leaf chlorophyll content) than that in the control
- The tree foliage was thicker than that in the control.

Durian roots recovered after 2 months of treatment with bio-organic fertilizers (left) and durian roots which were not treated with bio-organic fertilizers (right)

Durian shoots/leaves treated with bio-organic fertilizers (left) and in the control (right)

Durain tree var. Monthong affected by saline before the study (left) and after application of bio-organic fertilizers (right)

Durain foliage recovered after 2 months of applying bio-organic fertilizers

Study on saline tolerant rootstock for citrus

- Collecting lines/varieties of citrus in the nature for desaltation.

- Breeding hybrid combinations and evaluating their ability for saline tolerance for being rootstock.

- Evaluating compatibility of the citrus scions and the selected saline tolerant rootstock.

- Evaluating saline tolerance of the scion-rootstock combinations in the fields of the Mekong River Delta.

List of local citrus varieties and their hybrids for salinity assessment in net house condition

No	Varieties and hybirds	Scientific name	Source
1	Chanh Giấy	*Citrus aurantifolia*	Tien Giang
2	Quýt Đường	*Citrus reticulata*	Tien Giang
3	Chanh Tàu	*Citrus limonia*	Ben Tre
4	Cam Mật	*Citrus sinensis*	Tien Giang
5	Tắc (Hạnh)	*Citrus microcarpa* (Hassk.)	Ben Tre
6	Bưởi Long Hồng	*Citrus grandis*	Ben Tre
7	Sảnh	*Citrus* spp.	Ben Tre
8	Bưởi Hạt	*Citrus grandis*	Ben Tre
9	Cam Sen	*Citrus* spp.	Vinh Long
10	Bưởi Ổi	*Citrus grandis*	Binh Duong
11	Bòng	*Citrus* spp.	Hue
12	Bưởi Bánh Xe	*Citrus grandis*	Ben Tre
13	Bưởi Bung	*Citrus grandis*	Ben Tre
14	Bưởi Lông	*Citrus grandis*	Tien Giang
15	Bưởi Đường Hồng	*Citrus grandis*	Binh Duong
16	Bưởi Hồng Đường	*Citrus grandis*	Can Tho
17	B.Lông Cổ Cò x Cam Mật	*Citrus grandis x Citrus sinensis*	SOFRI
18	B.Lông Cổ Cò x B.Da Xanh	-	SOFRI
19	B.Lông Cổ Cò x Orlando	*Citrus grandis x (C. paradisi x C. reticulata)*	SOFRI
20	B. Lông Cổ cò x B.Chua	-	SOFRI
21	B. Da Xanh x x Orlando	*Citrus grandis x (C. paradisi x C. reticulata)*	SOFRI
22	B.Da Xanh x B.Lông Cổ Cò	-	SOFRI
23	Tắc x B.Lông Cổ Cò	*Citrus microcarpa* (Hassk.) x *Citrus grandis*	SOFRI
24	Tắc x B. Da Xanh	*Citrus microcarpa* (Hassk.) x *Citrus grandis*	SOFRI
25	B. Da Xanh x Cam Mật	*Citrus grandis x Citrus sinensis*	SOFRI
26	Cam Mật x B. Da Xanh	*Citrus sinensis x Citrus grandis*	SOFRI
27	Carrizo citrange (chuẩn nhiễm mặn)	*Poncirus trifoliate* (L.)Raf.x*Citrus sinensis*(L.) Osb.	Japan
28	Cleopatra mandarin (Standard saline tolerance)	*Citrus reshnii* Hort ex Tan.	America

Evaluation of saline tolerant citrus varieties

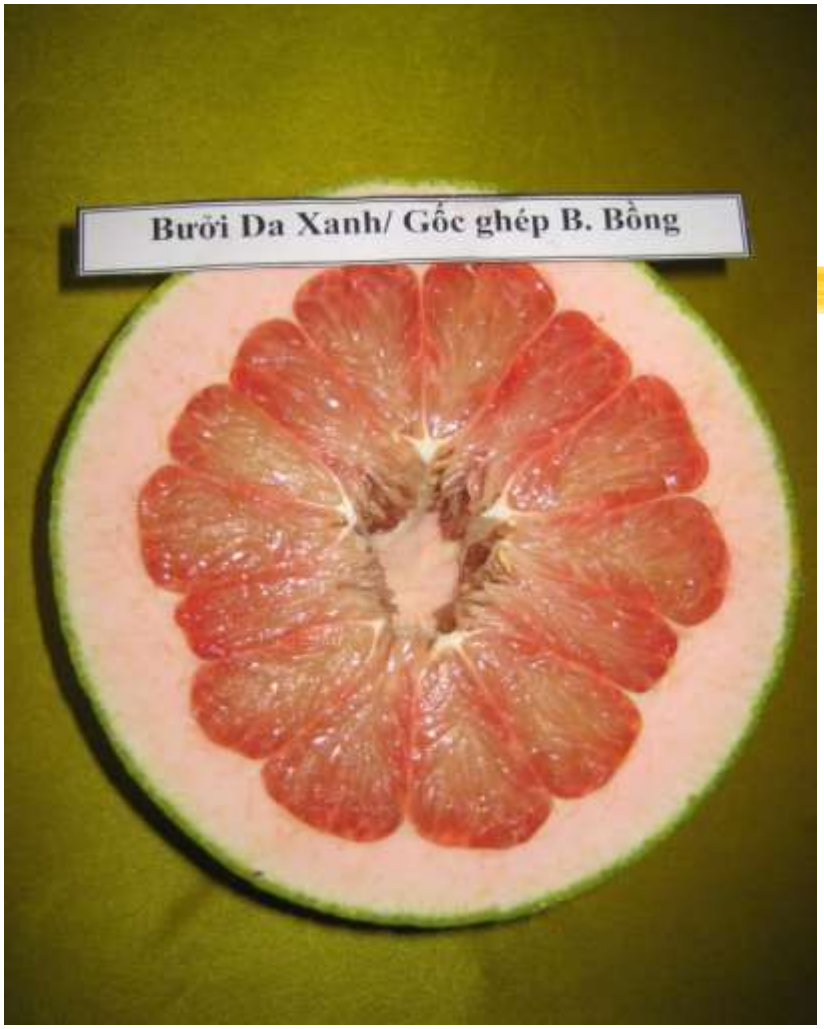
Results of selecting saline tolerant citrus rootstocks

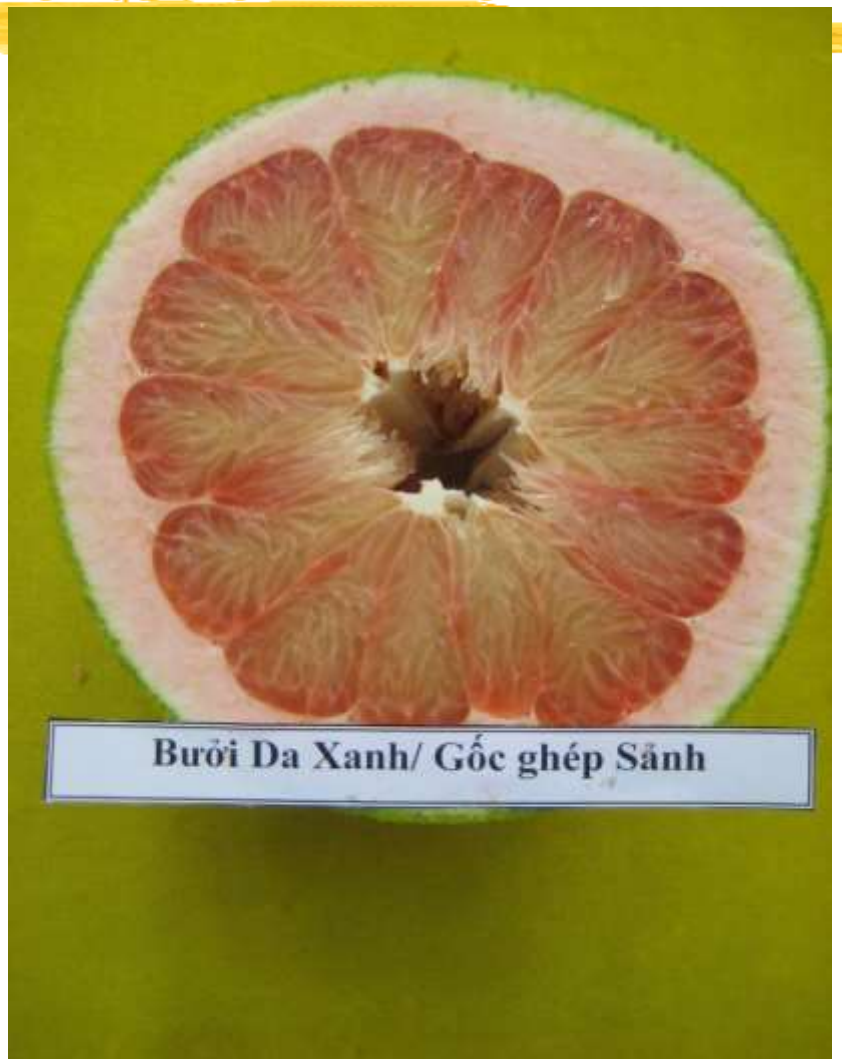
- Sanh (Ben Tre), Bong (Hue), Bung pomelo (Ben Tre), Hong Duong pomelo (Can Tho), Duong Hong pomelo (Binh Duong) as rootstock for scion of Da Xanh/Nam Roi pomelo.

- The rootstocks could grow in the Mekong River Delta where the salt concentration was upto 8‰ within the duration of 60 days.

Da Xanh/ Hong Duong pomelo

Da Xanh pomelo / Bong


Bưởi Da Xanh/ Gốc ghép B. Bồng


Bưởi Da Xanh/ Gốc ghép Sảnh

Research on saline tolerant mango rootstocks

Study on saline tolerance of 8 local and introduced mango varieties: Canh Nong (Khanh Hoa), Chau Hang Vo (Tra Vinh), Cat Hoa Loc (Tien Giang), Cat Chu (Dong Thap), 13 -1 (Israel), Ghep xanh (Tien Giang), Thanh ca (Tien Giang), Thom (An Giang).

Results of research on saline tolerant mango rootstocks

- Canh Nong (Khanh Hoa), Chau Hang Vo (Tra Vinh), 13 -1 (Israel), Ghep xanh (Tien Giang), Thom (An Giang) to be rootstocks for Cat Hoa Loc and Cat Chu mango scions.

- The rootstocks could grow in saline area with salt conc. of 10 - 13‰ within the duration of 60 days.

Research on drought tolerant citrus rootstocks

Local citrus varieties for selection of drought tolerant citrus rootstock in nethouse condition

No	Varieties	No.	Varieties
1	B. Thanh Trà	16	Bưởi Hạt-1
2	B. Bồng-1	17	Trúc
3	B. Bồng-2	18	Bưởi BX
4	B. Đường	19	Chanh Eureka
5	B. Ngang-2	20	B. Ngang-1
6	B.Bung (LA)	21	Chanh giấy
7	Bưởi Hạt-2	22	B. LCC-1
8	Bưởi ĐDL	23	B. Hạt-3
9	Bưởi Dây	24	BLCC x CM
10	Bưởi Hạt-4	25	Sảnh
11	Bưởi Huyết	26	Bưởi BX
12	B. Chua (ĐN)	27	B. Bung (BT)
13	Bưởi Đỏ-3	28	Hạnh
14	Bưởi Đỏ-2	29	Tắc x BLCC
15	Bưởi Đỏ-1	30	Carrizo

Results of research on drought tolerant citrus rootstocks

- Cay Truc (An Giang), buoi Chua pomelo (Dong Nai), buoi Do (Long An), buoi Thanh Tra (Long An) to be rootstocks for citrus trees (King mandarin, pomelo).

- The rootstock could grow in drought areas and tolerant to dorught within 30 days.

Nam roi/Buoi Chua

Da xanh/Buoi Chua

King mandarin/Truc

CONCLUSION

- Vietnam has diversified climate condition to produce different fruit crops. The fruit and vegetable export turnover has seen increase in recent years, contributing to the national agricultural export value.

- Vietnam is one of the countries that have suffered the most from climate change, causing great impacts on agriculture, including fruit production. Floods, long drought and saline intrusion has happened more frequently with more severe influence.

- The government has currently established strategies to deal with climate change in future scenarios; gradually transforming the production towards promoting use of varieties adaptive to draughts and saline intrusion.

- Vietnamese scientists have been initially successful in breeding fruit cultivars, rootstocks resistant to diseases, tolerant to drought and salinity for sustainable fruit production in climate change.

Thank you
for your attention !