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Healthier diets, more resilient livelihoods

The Applications of TAsVI Germplasm

LIn, Yann-rong
Deputy Director General – Partnerships

17th AARNET
Brunei
30 May 2023

The nutritional power of vegetables

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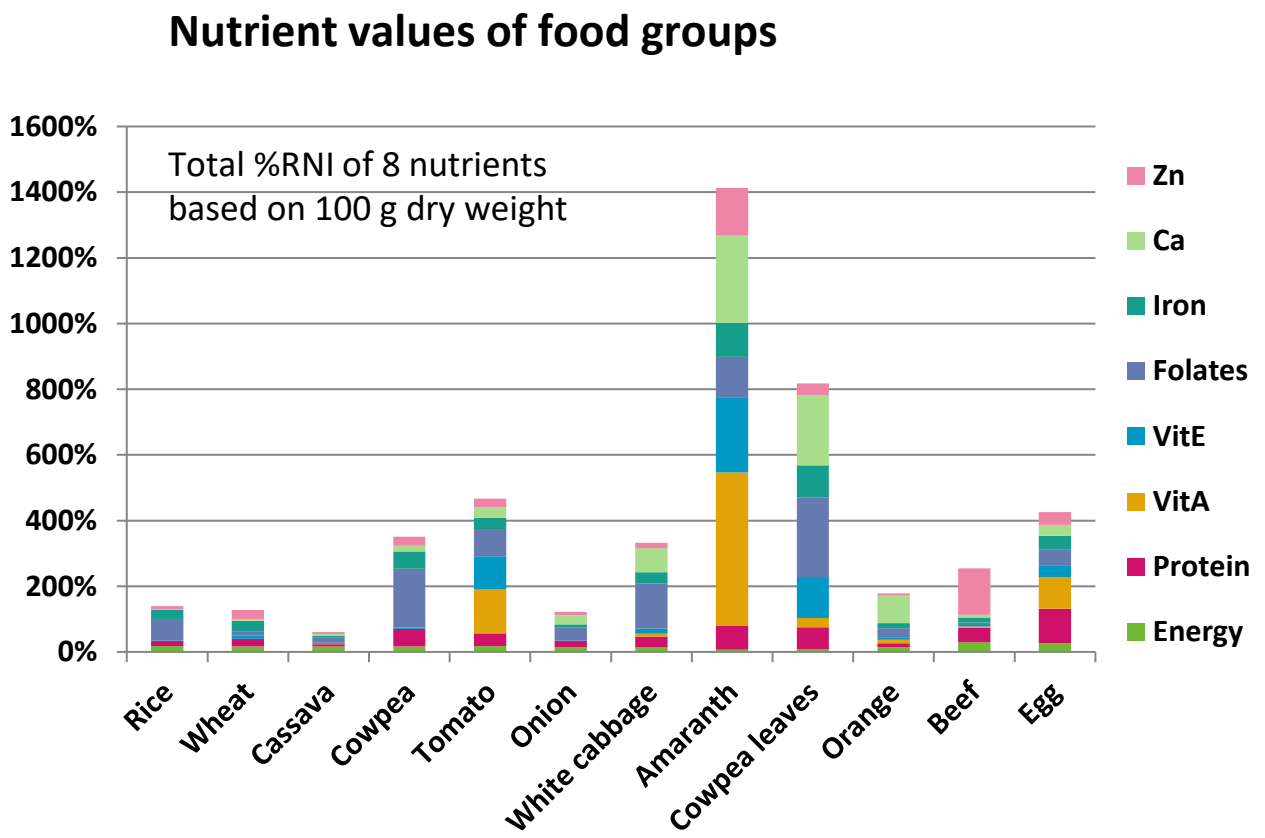
- Human diets are mainly based on three crops - rice, maize and wheat that provide 60% of the world's food energy intake and 15 crops make up 90% of the energy supply
- Vegetables are highly diverse in terms of species and varieties as well as phytonutrients (essential nutrients, dietary fibers and bioactive phytochemicals) in them
- Vegetables to ameliorate micronutrient deficiencies



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RNI: recommended nutrient intake

Courtesy: Ray-yu Yang, Nutritionist, World Vegetable Center

The Impacts and Importance of Vegetables

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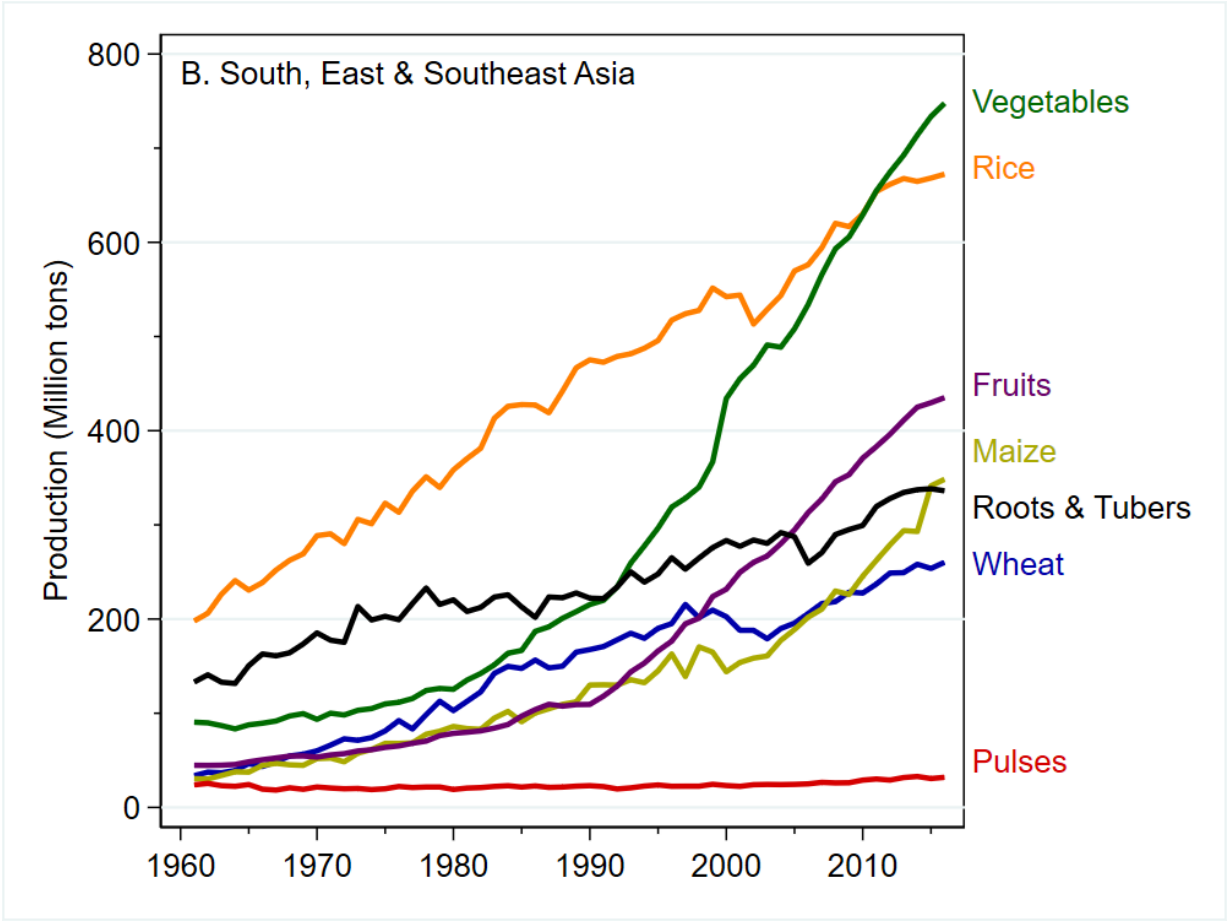
"Transformation to healthy diets by 2050 will require substantial dietary shifts. Global consumption of fruits, vegetables, nuts and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%." EAT-Lancet Commission report, 2018

"Shift the weight of funding toward a new generation of "staple" foods—which today the system treats as specialty or alternative, but really are staples of a healthy diet. Fruits, vegetables, and legumes need a greater share of public and private research dollars as well as risk protection". Rajiv Shah – Rockefeller Foundation, 2018.

"The vast majority of current subsidies are focused on staple grains such as wheat, rice and maize, with very little investment in fruits, vegetables and nuts, which should be part of a healthy diet. We keep supporting agricultural processes that pollute and mine the world's resources, over more sustainable and resilient approaches. We can change that." Juergen Voegele - World Bank, 2018.

Green Revolution in Asia



WorldVeg graphics
FAOSTAT, 2019

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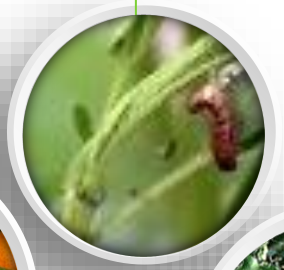
Fields

Improved varieties

Improved & Safer Production practices



Post-harvest & Processing

Marketing

Tables

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Food security: 15 crops...or 2,000 crops?!

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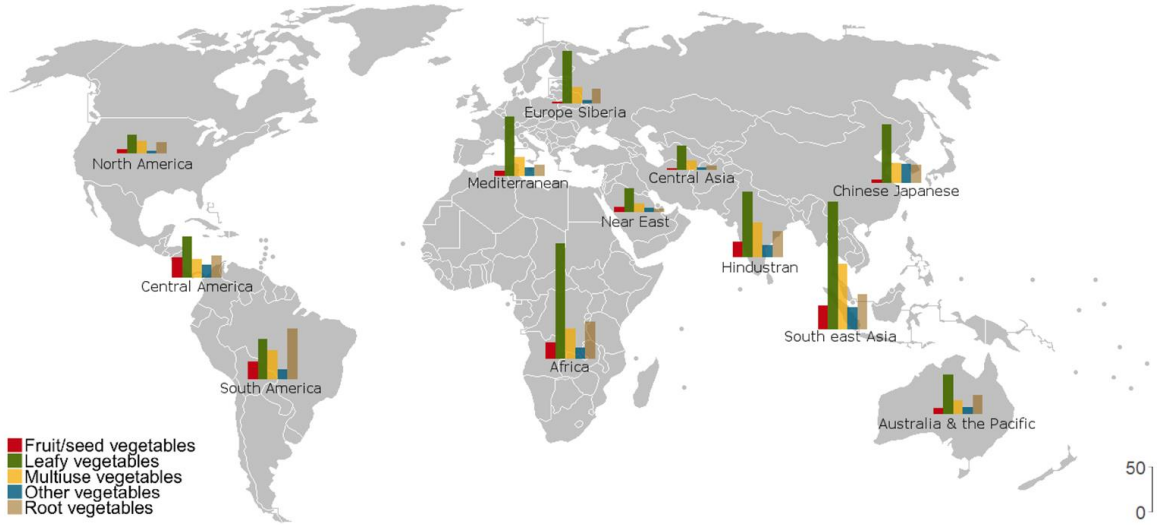
South Asia and South East Asia is the hotspot of vegetable diversity



Meldrum et al. (2018)

- **Resilience to climate**
  - ✓ heat tolerance
  - ✓ drough tolerance
  - ✓ flooding tolerance
- **Resilience to pest and pathogen**
  - ✓ Resistance to tropical and sub-tropical pets and pathogen
- **Traditional Crops**
  - ✓ special nutritions
  - ✓ Traditional application
  - ✓ Traditional culture related

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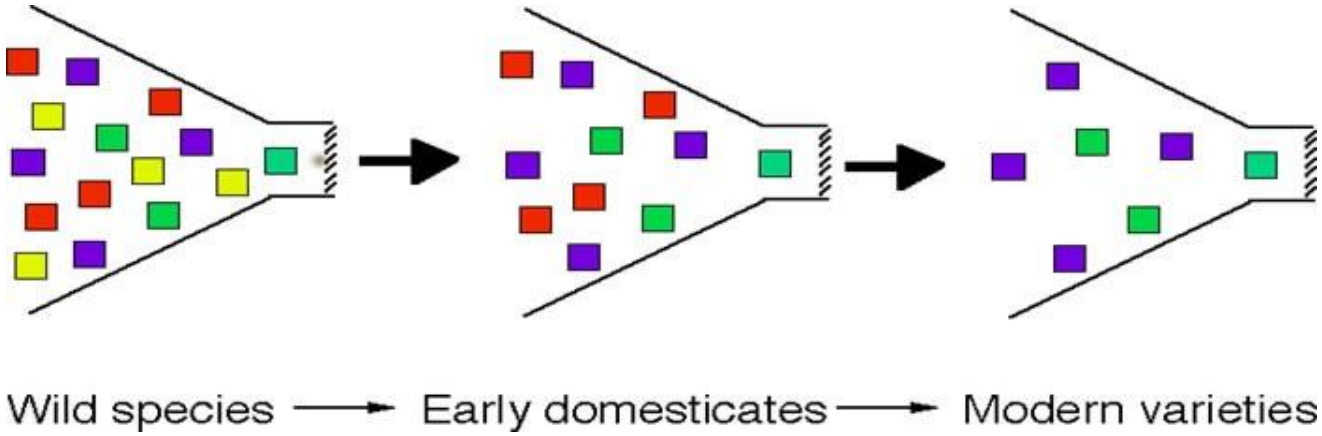
Vegetable Diversity in the old varieties (landrace)



https://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1130447284&topicorder=4&maxto=9&minto=1

Domestication reduced the genetic diversity of crops compared to their wild ancestors

Reduced diversity limits ability of crops to adapt to new environments and stresses

BvWettberg E. 2018 Nature Communications **9:** 649

Trait characterization

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Taiwan-Southeast Asia Vegetable Germplasm Initiative (TAsVI)












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Taiwan-Southeast Asia Vegetable Germplasm Initiative (TAsVI)

Malaysia's unique and lost vegetable varieties

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Accessions:
VI033475、VI055050

Accessions:
VI033489

Species:
Amaranthus

Accessions:
VI055220

Species:
Abelmoschus esculentus

Traditional Knowledges of Indigenous People

►阿美族常食用的野菜

►阿美族部落的菜園

►「雨來菇人工栽培與應用」研究榮獲第 17 屆國家新創獎的肯定

►藉由出版專刊協助保存部落傳統農耕知識及飲食文化

https://www.hdares.gov.tw/i_theme_data.php?theme=highlights_news&id=18&print=Y

Micronutrients

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Micronutrient content of common and traditional vegetables





	Ranges	Chinese cabbage	African nightshade*	Amaranth	Vegetable cowpea leaves	Jute mallow
β-Carotene,mg	0.0 – 25	0.00	4.84	9.23	9.39	9.46
Vit C, mg	1 - 1983	22	119	113	76	128
Vit E, mg	0 – 71	0.05	2.62	3.44	9.21	2.81
Iron, mg	0.1 - 26	0.30	2.61	5.54	2.03	3.64
Folates, µg	0 – 349	ND	81	78	167	53
Antioxidant activity, TE	71 - 82,000	496	1722	394	1925	2048

Per 100 g fresh weight

**Solanum scabrum*

Source: WorldVeg Nutrition Lab

Functional Characterizations

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表三. 台灣原生蔬菜功能潛力
(AI:抗發炎； AC:抗癌； AO:抗氧化； AM抗菌； AD抗糖尿)

Chinese Name	Scientific name	AI	AC	AO	AM	AD	Others
秋葵	*Abelmoschus esculentus*	v		v	v		v
火蔥	*Allium ascalonicum*	v	v	v			v
蒜蔞	*Allium chinense*	v	v				
月桃	*Alpinia zerumbet (Pers.) Burtt & Smith = Alpinia speciosa (Windl.) K. Schum.*			v			v
莧菜	*Amaranthus mangostanus L.*	v	v	v	v	v	v
青莧	*Amaranthus patulus Betoloni*			v		v	v
刺莧	*Amaranthus spinosus*	v		v	v	v	v
野莧	*Amaranthus viridis*	v		v			v
檳榔花	*Areca catechu*	v		v		v	v
艾草	*Artemisia argyi Artemisia princeps Pamp. var. orientalis(Pamp.) Hara*	v	v	v			v
麵包果	*Artocarpus incisus*						v
山蘇花	*Asplenium antiquum Makino*			v			
山蘇	*Asplenium australasicum*						v
台灣山蘇花	*Asplenium nidus L.*		v	v		v	
山芥菜	*Barbarea orthoceras Ledeb.*	v		v			v
落葵	*Basella alba L.*	v			v		v
水鴨腳	*Begonia formosana (Hayata) Masam.*	v		v			
鬼針草	*Bidens pilosa var. pilosa*				v		
咸豐草	*Bidens pilosa L. var. minor (Blume) Sherff*		v		v		
茄苳	*Bischofia javanica Blume*	v		v		v	v
青苧麻	*Boehmeria nivea*	v		v		v	
構樹雄蔬	*Broussonetia papyrifera*		v	v	v		
樹豆	*Cajanus cajan (L.) Millsp.*	v		v			
藤心	*Calamus margaritae Hance*						v
濱刀豆	*Canavalia rosea (Sw.) DC.*					v	
美人蕉	*Canna indica*	v		v			v
辣椒葉	*Capsicum annuum*	v					
小米辣椒	*capsicum frutescens*	v		v		v	
細葉碎米薺	*Cardamine flexuosa*			v			
紅果薹	*Carex baccans Nees*			v	v	v	
蒺藜草	*Cenchrus echinatus L.*						v
山柚	*Champereia manillana (Blume) Merr.*						v
小葉灰藋	*Chenopodium serotinum*	-	-	-	-	-	-
海州常山	*Clerodendrum trichotomum Thunb.*						v
芋梗	*Colocasia esculenta*		v	v	v	v	
黃麻	*Corchorus capsularis*	v	v	v		v	v
破布子	*Cordia dichotoma Forst. f.*		v	v			v
大葉貝蕨	*Cornopteris fluvialis (Hayata) Tagawa*	-	-	-	-	-	-
昭和草	*Crassocephalum crepidioides*		v		v		
鴨兒芹	*Cryptotaenia japonica Hassk.*			v		v	v
南瓜心	*Cucurbita moschata*						v
鬱金(薑黃)	*Curcuma longa*	v	v	v		v	v
刺柄碗蕨	*Dennstaedtia scandens (Blume) Moore*	-	-	-	-	-	-
茯苓菜	*Dichrocephala integrifolia (L.f.) Kuntze*	v					v
山藥-紫	*Dioscorea alata*	v	v	v		v	v
廣葉鋸齒雙蓋蕨	*Diplazium dilatatum Blume*						v
過貓	*Diplazium esculentum*				v		
擬德氏雙蓋蕨	*Diplazium pseudo-doederleinii Hayata*	-	-	-	-	-	-
紫背草	*Emilia sonchifolia (L.) DC. = Emilia sonchifolia (L.) DC. var. javanica (Burm.f.) Mattfeld*	v	v				v
裂葉昭和草	*Erechtites valerianifolia*					v	
天仙果	*Ficus formosana Maxim.*	v	v	v	v	v	v
雀榕	*Ficus superba (Miq.) Miq. var. japonica Miq. = Ficus wightiana Wallich*	v	v	v	v	v	v
茴香	*Foeniculum fulgare*	v		v	v		v
鼠麴草	*Gnaphalium affine D. Don.*	v					v
糯米糰	*Gonostegia hirta*	v					v
石蓮花	*Graptopetalum paraguayense*	v	v				
野薑花	*Hedychium coronarium*						v
菊芋	*Helianthus tuberosus L*				v	v	
金針	*Hemerocallis fulva (L.) L.*		v		v		
朱槿	*Hibiscus rosa-sinensis L.*			v	v		v
魚腥草	*Houttuynia cordata*	v		v	v	v	v
燈稱花	*Ilex asprella (Hook. & Arn.) Champ.*	v		v		v	v
馬鞍藤	*Ipomoea pes-caprae (L.) Sweet subsp. brasiliensis (L.) Oostst.*						v
地瓜葉	*Ipomoea batatas*	v		v			
刀傷草	*Ixeridium laevigatum (Blume) J. H. Pak & KawanoIxeridium laevigatum (Blume) J. H. Pak & Kawano*	-	-	-	-	-	-
兔兒草	*Ixeris chinensis*		v				
克蘭樹	*Kleinhovia hospita L.*		v			v	v
鵝豆	*Lablab purpureus (L.) Sweet*			v			v
山萬苣	*Lactuca indica L.*						v
結球萬苣	*Lactuca satica*	-	-	-	-	-	-
山萬苣	*Lactuca sororia Miq.*	-	-	-	-	-	-
扁蒲	*Lagenaria leucantha (Duchesne) Rusby*						v
大葉楠	*Machilus japonica Sieb. & Zucc. var. kusanoi (Hayata) Liao = Machilus kusanoi Hayata*	v		v			
豬腳楠	*Machilus thunbergii Sieb. & Zucc.*		v				v
台灣牛繩菜	*Marsdenia formosana Masam.*	-	-	-	-	-	-
山豬肉	*Meliosma rhoifolia Maxim.*	-	-	-	-	-	-
苦瓜	*Momordica charantia*	v		v	v		v
野苦瓜	*Momordica charantia L*	v		v	v		v
木鱉葉	*Momordica cochinchinensis*			v			v
西洋菜	*Nasturtium offcinale*	v	v	v	v	v	v
蓮子	*Nelumbo nucifera*	v		v			
腎蕨	*Nephrolepis auriculata (L.) Trimen = Nephrolepis cordifolia Presl*				v		v
萬仙米藻	*Nostoc commune*	v		v		v	
羅勒	*Ocimum basilicum L.*				v		v
水芹菜	*Oenanthe javanica*	v			v		v
巴茅菜(假人茅)	*Talimum paniculatum*			v		v	v
林投	*Pandanus odoratissimus L. f.*		v				v
山苦黃	*Paraprenanthes sororia (Miq.) C. Shih*	-	-	-	-	-	-
紫蘇	*Perilla frutescens (L.) Britt.*	v					v
菜豆	*Phaseolus limensis*	v		v		v	
蘆葦心	*Miscanthus floridulus*	-	-	-	-	-	-
車前草	*Plantago asiatica L.*				v		v
火炭母草	*Polygonum chinense*	v	v	v	v	v	v
馬齒莧	*Portulaca oleracea*	v		v			v
山蕨	*Pteridium aquilinum (L.) Kuhn subsp. latiusculum (Desv.) Shieh*						v
瓦氏鳳尾蕨	*Pteris wallichiana Ag.*						v
羅氏鹽膚木	*Rhus javanica L. var. roxburghiana (DC.) Rehd. & Wilson = Rhus semialata Murr.var.roxburghiana DC = Rhus chinensis Mill. var. roxburghiana (DC.) Rehd*	v	v				
野漆樹	*Rhus sylvestris siebold & zucc.*	v					
龍鬚菜	*Sechium edule*						v
光果龍葵	*Solanum americanum*						v
龍葵	*Solanum nigrum L.*	v	v	v		v	v
茅瓜	*Solena amplexicaulis (Lam.) Gandhi*						v
苦苣菜	*Sonchus arvensis L.*				v		
苦滇菜	*Sonchus oleraceus L.*		v				
筆筒樹	*Sphaeropteris lepifera (Hook.) Tryon = Cyathea lepifera (J. Sm.) Copel*						v
車輪茄	*Solanum integrifolium Poir*	v					
鵝兒腸	*Artemisia lactiflora*			v			
香椿	*Toona sinensis (Juss.) M. Roem.*						v
蛇瓜	*Trichosanthes anguina L.*					v	
豇豆	*Vigna sinensis (L.) Endl. ex Hassk. = Vigna unguiculata (Linn.) Walp.*				v		v
黃鵝菜	*Youngia japonica (L.) DC.*						v
食茱萸	*Zanthoxylum ailanthoides Sieb. & Zucc.*		v				

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http://nutrition.worldveg.org/

Micronutrient database

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Ethiopian mustard

Local Name :	非洲芥藍
Common Name :	Ethiopian mustard
Scientific Name :	*Brassica carinata*
Part :	Leaf
Color :	Green

Plant information

Recipes

Year : 2006 [non-specified]

Nutrient	Unit	Value per 100g
Vitamins		
alfa-Carotene	mg	N.D
alpha-Tocopherol	mg	1.76
Ascorbic acid	mg	183.00
beta-Carotene	mg	0.29
delta-Tocopherol	mg	N.D
Folate	mcg	107.00
gamma-Tocopherol	mg	N.D
Neoxanthin	mg	1.82
Total Tocopherol	mg	1.76
Violaxanthin	mg	3.16
Lutein	mg	4.96
Minerals		
Calcium	mg	153.00
Iron	mg	1.39
Zinc	mg	0.72
Others		
Antioxidant (ABTS)	µmol Trolox	849.00
Dry Matter	g	11.30
Fiber	g	1.48
Linoleate (18:2 n-6)	mg	42.00
Linolenate (18:3 n-3)	mg	127.00

http://nutrition.worldveg.org/

Vegetable Powder

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蔬菜粉茶

- 利用茶葉乾燥與磨粉技術
- 使蔬菜加工成蔬菜片及蔬菜粉，可應用於飲料及食品
- 改變風味、使用便利、延長蔬菜保存期限

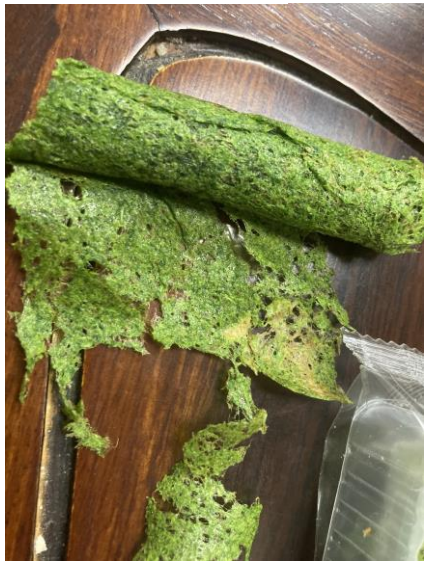
Tea Research & Extension Station (TRES), Taiwan

The Applications of Vegetable Powders





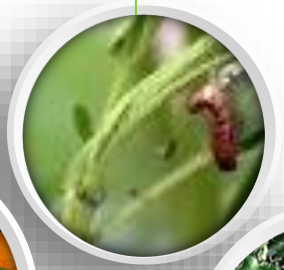

Tea Research & Extension Station (TRES), Taiwan


Fields

Improved varieties

Improved & Safer Production practices



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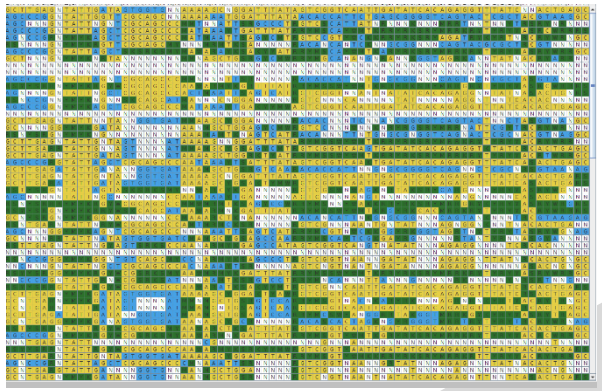

Variety development

Breeding

~ 10 years

Pre-breeding

Introgress trait into cultivated material

Genebank screening

Screening protocol

Screening population

$$\text{Genetic gain} = \frac{\text{selection intensity} * \text{accuracy} * \text{genetic variance}}{\text{years/cycle}}$$

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Screening Resistance to Biotic Stresses

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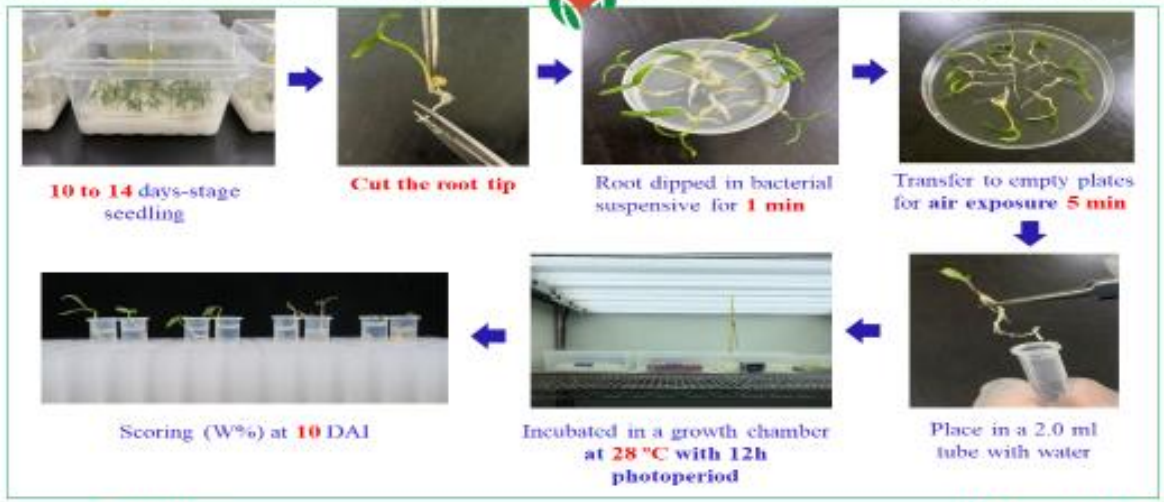
A rapid screening system to assess bacterial wilt in pepper

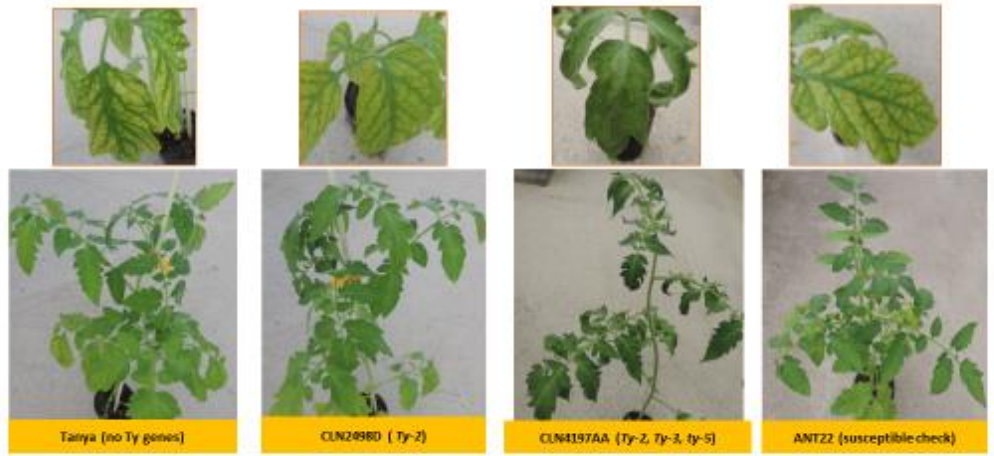


- 207 **pepper** germplasm accessions were evaluated to bacterial wilt and **30 accessions showed resistance**
- Tomato breeding lines resistance to bacterial wilt show high consistency: **82.5%** (Pss4) and **93.7%** (PSS1632)
- **247 pepper** core collections resistance to bacterial wilt are evaluated by rapid screening system

Jaw-rong, Yun-chen, Huang & Sean-yuet, Lara Brindisi, Ya-ping, Derek

Evaluation of tomato TY genes for reaction to Tomato chlorosis virus (ToCV; Crinivirus)

- A total of 20 tomato breeding lines with various combinations of **Ty genes** were evaluated for the reaction of **ToCV** infection.
- None of the test lines were immune to ToCV; however, most of the lines harboring ***Ty-2, Ty-3/Ty-3a*** and ***ty-5*** appeared to **enhance the tolerance** of tomato plants to ToCV infection.



Sophia *et al.*

Virus-resistant tomato germplasms screening out

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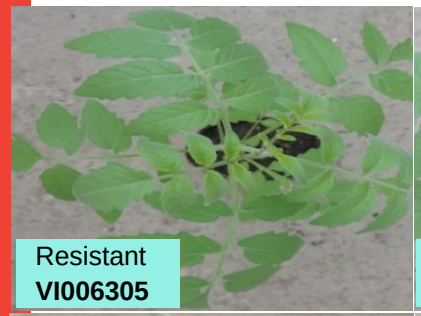
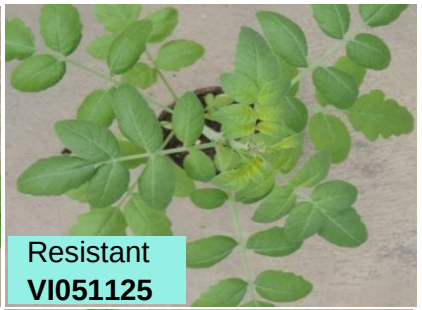
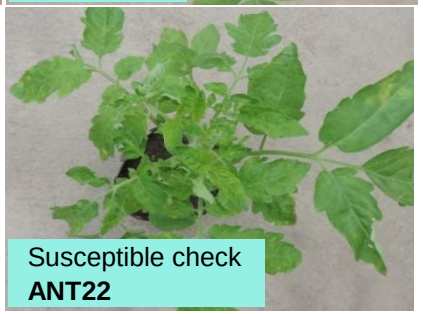
TSWV-resistant accessions







ToCV-tolerance accessions

- The plants from 6 TSWV-resistant accessions showed symptomless on the newly developed leaves.
- The evaluation indicated that VI037301 and VI037331 have the potential of resistance/ tolerance to ToCV.

Screening Resistance to Biotic Stresses

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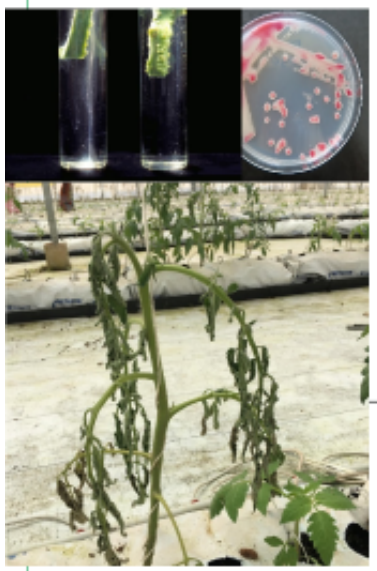
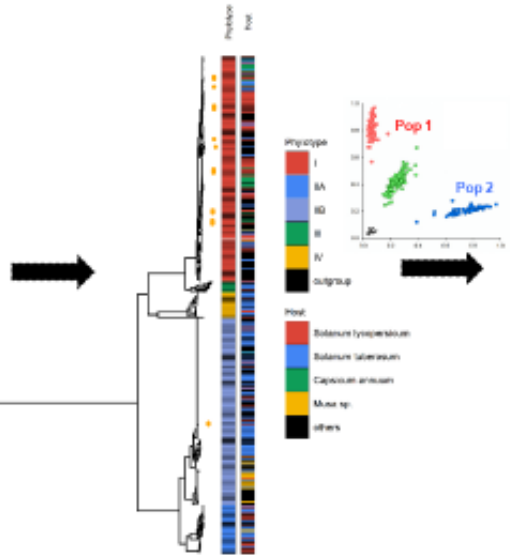
Developing molecular tools for disease surveillance

1. Collection of diversity in the vegetable-growing areas
2. Genome analysis and development of molecular tools
3. Real-time high throughput field monitoring





~2300 entries

450 Genomes

20 SNP markers

200 accessions for tomato and chili pepper each
Screening resistant lines

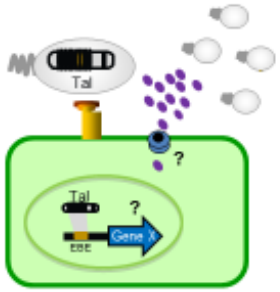
Integrative disease resistance breeding for Vegetables

Trat-discovery pipeline
- Germplasm Screening
- GWAS/Mapping
- QTL/gene identification
- Pathogen characterization
- Effector-based mapping

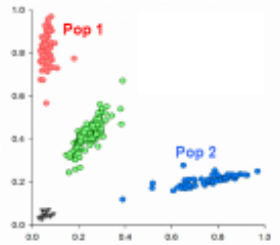
Pre-breeding pipeline
- QTL/gene validation
- Linkage drag reduction
- Effector-based validation
- Pathogen surveillance

Breeding and Deployment
- Multi-location test
- Variety development
- Pathogen-informed decisions
- Disease monitoring

e.g. Exploiting effectors for gene discovery



e.g. Developing tools for surveillance



e.g. Developing monitoring platforms

Screening Resistance to for Abiotic Stresses

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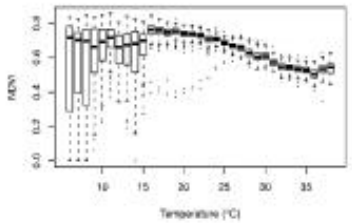
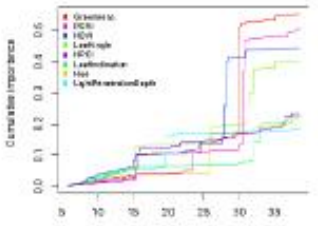
- **Heat tolerance**
  - tomato
- **Drought tolerance**
  - Okra
  - amaranth.

High-throughput Phenotyping germplasm

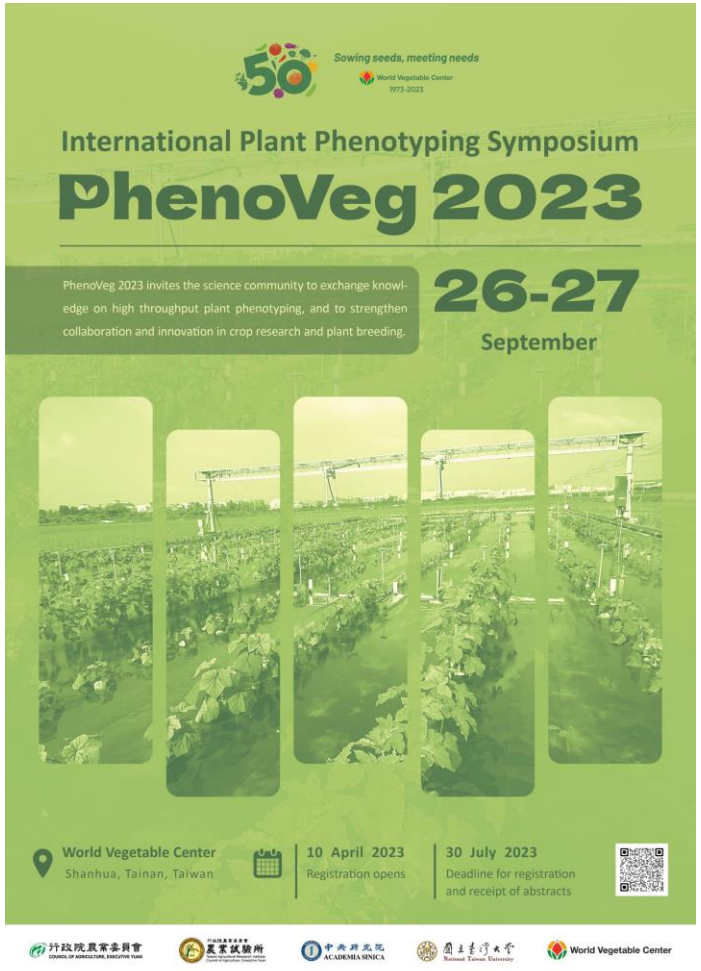
- PhenoSpex
  - Pepper
  - Okra
  - Amaranths

- Morphological traits
  - Plant height
  - Leaf area
  - Biomass
  - Leaf angle
- Spectral traits
  - Greenness
  - Hue
- Spectral vegetation index
  - NDVI
  - NPCI
  - PSRI





The distribution of traits along the temperature gradient, ex. NDVI
Using AI to estimate the sensitivity (cumulative R2) and response threshold (huge jump of cumulative R2) for every trait



Omics Breeding

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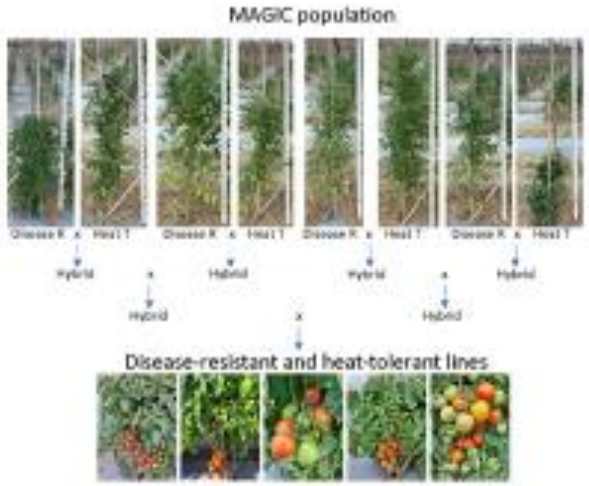
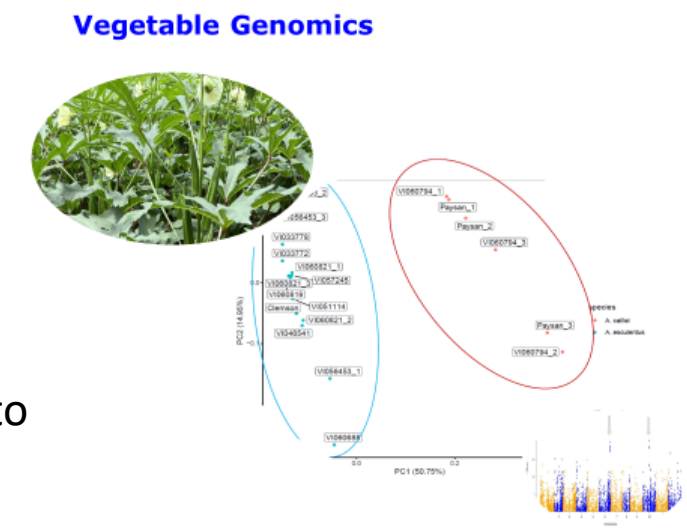
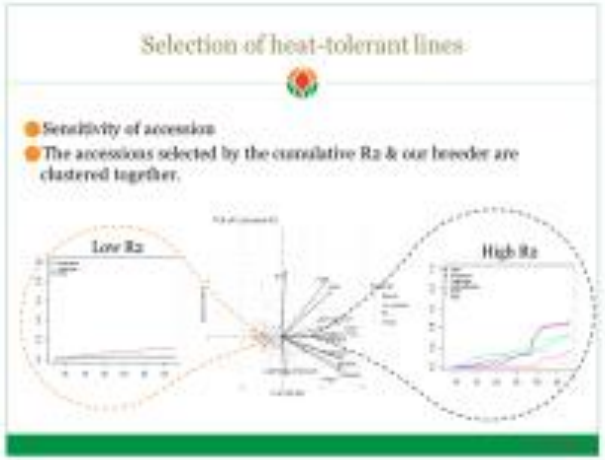
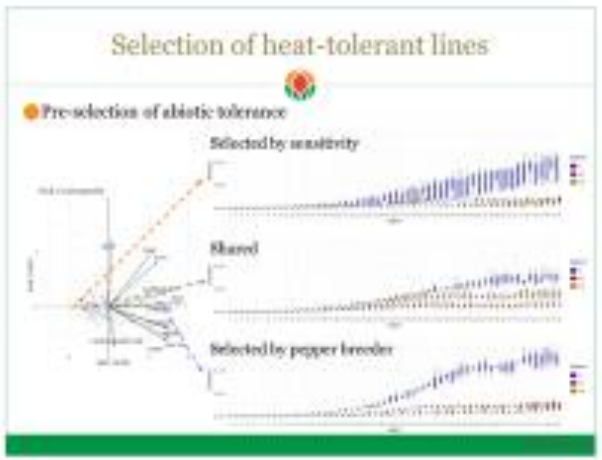


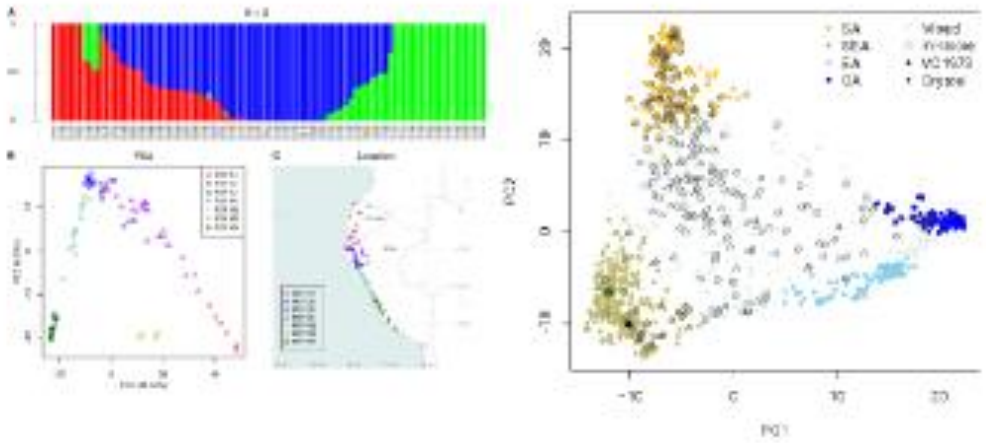
Landscape genomics
Chili pepper and tomato



- k-mer mapping was successfully tested on tomato and pepper, and then on okra, a species with a complex allopolyploid genome lacking a publicly accessible reference sequence as a genomic tool for diversity analysis and mapping







Marker-assisted Breeding

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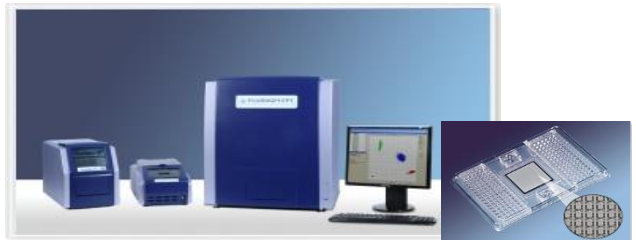
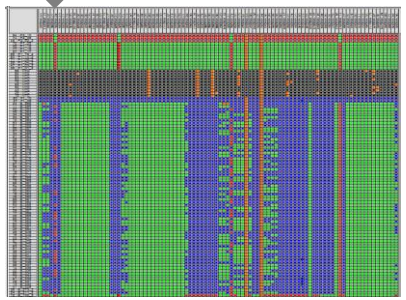
High-throughput genotyping

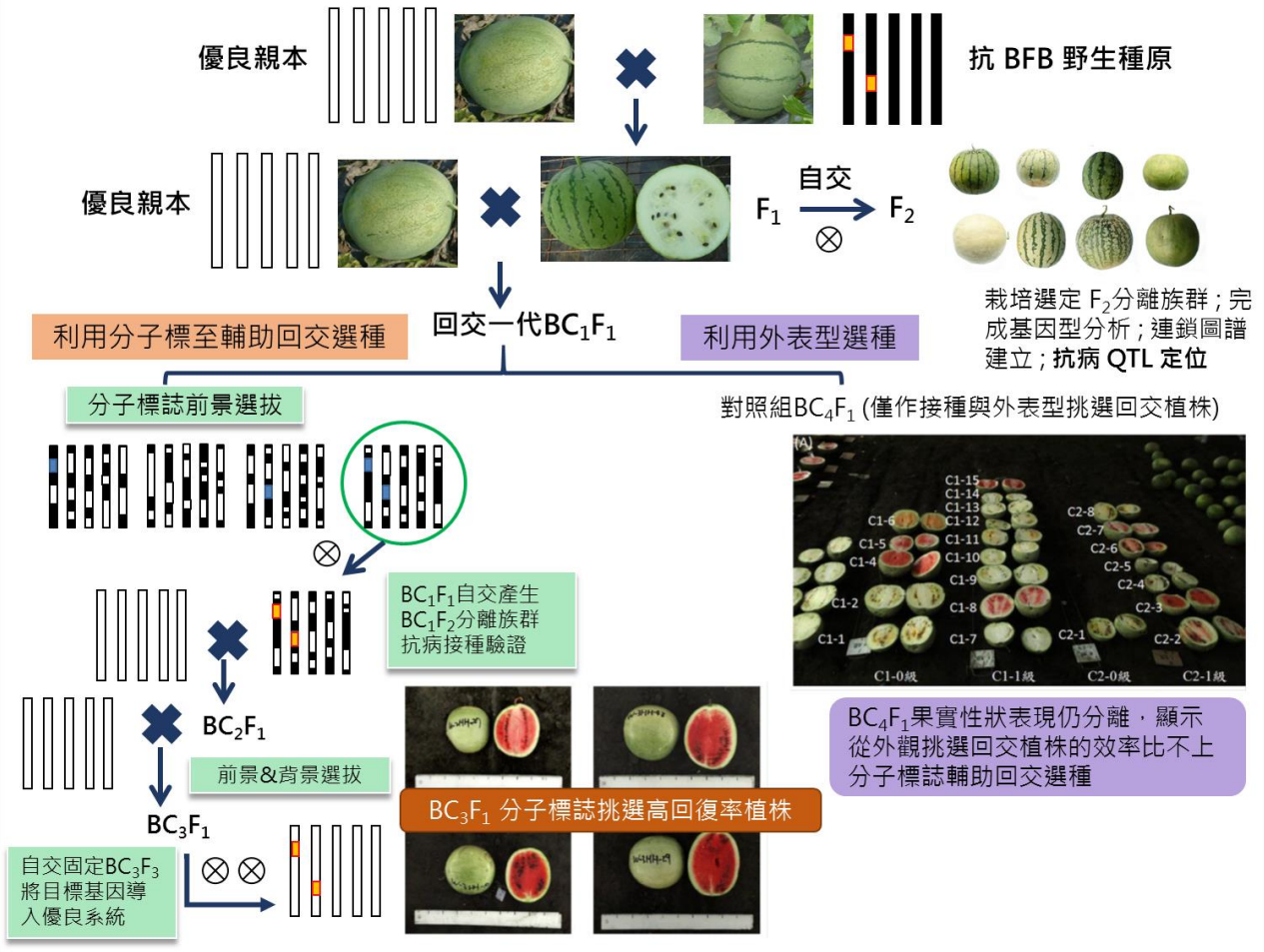


晶片影像

資料點整理

一片晶片完成
9216資料點





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KNOWN-YOU SEED CO., LTD.

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Thanks

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