



# **Development and Application of Seed Inspection Technology in Taiwan**

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**Taiwan Seed Improvement and Propagation  
Station (TSIPS), Ministry of Agriculture**



# We'll talk about ...

- **Accredited laboratories of TSIPS**
- **Present seed testing service**
- **Recent research and development for seed testing**





# Accredited Laboratories of TSIPS

## □ TAF (Taiwan Accreditation Foundation) accredited laboratory

- Original accredited: 2008
- Accreditation criteria: ISO 17025: 2017



## □ ISTA (International Seed Testing Association) accredited laboratory

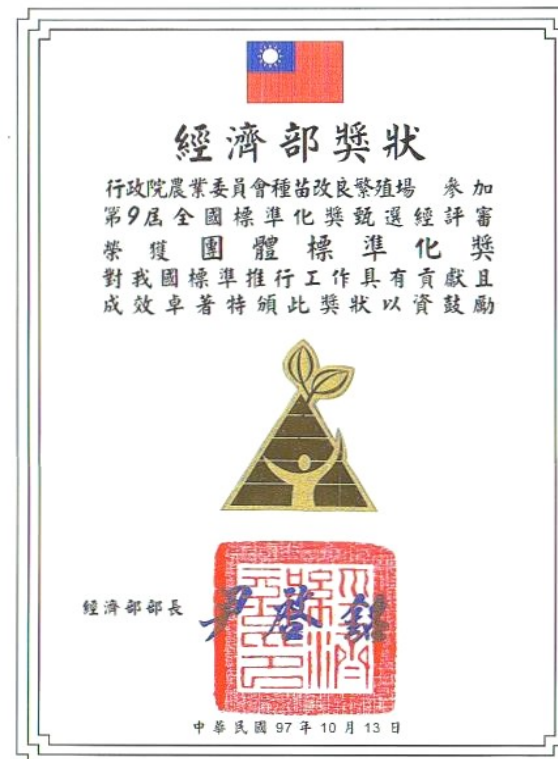
- Participating ISTA: 1962
- Original accredited: 2001
- Accreditation criteria: ISTA Accreditation Standards



# TAF accredited laboratory



Testing Laboratory  
1982





# Service of TAF accredited lab

Item/Method	Scope of accreditation
GM crop/PCR	Soybean, Corn, Papaya, Potato, Cotton
Virus/ELISA	CGMMV and CMV (on cucurbits) PLRV 、 PVS 、 PVX 、 PVY (on potato) BICMV (on beans) DsMV and TuMV (on calla lily) CymMV and ORSV (on orchids)
Virus/PCR	CymMV and ORSV (on orchids) ToMV (on Solanaceae)
Bacteria/ELISA	<i>Acidovorax citrulli</i> (on cucurbits)
Bacteria/PCR	<i>Xanthomonas campestris</i> pv. <i>campestris</i> (on Brassica)





# Service of TAF accredited lab

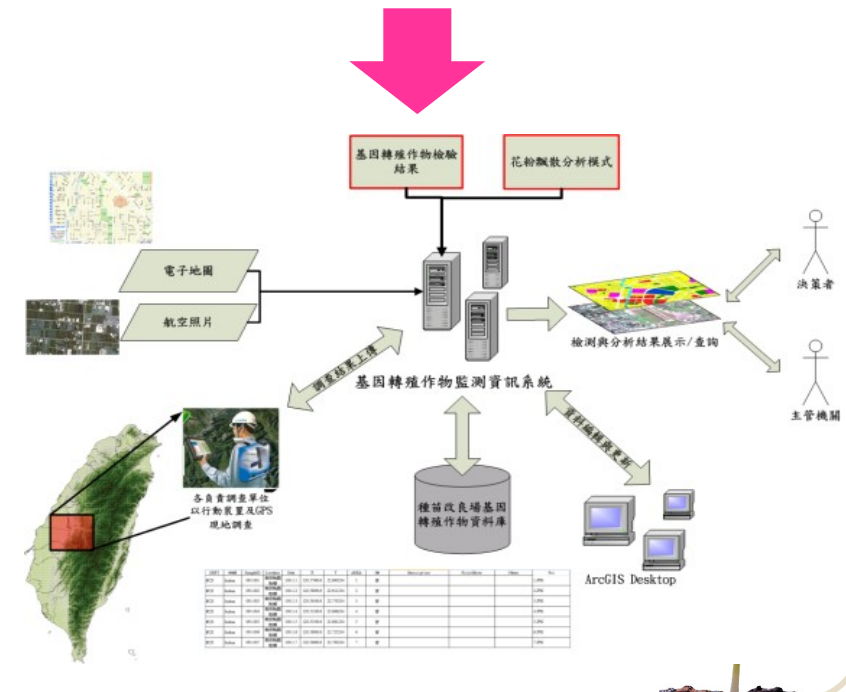
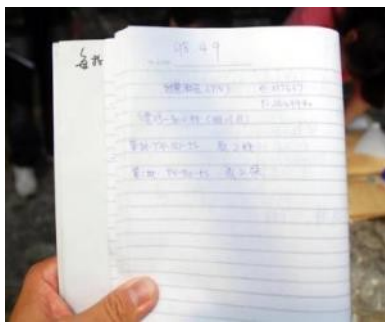
Item/Method	Not in scope of accreditation
<b>Virus/ELISA</b>	TMV and PMMoV (on Solanaceae) PSbMV and PEBV (on Pea) SqMV, MNSV and PepMV (on cucurbits)
<b>Virus/PCR</b>	ToBRFV and ToMMV (on Solanaceae)
<b>Bacteria/ culture+PCR</b>	<i>Xanthomonas</i> spp., <i>Pseudomonas syringae</i> pv. <i>tomato</i> , <i>Ralstonia solanacearum</i> , <i>Clavibacter michiganensis</i> subsp. <i>michiganensis</i> (on Solanaceae) <i>X. campestris</i> pv. <i>raphani</i> , <i>Pectobacteria</i> (on Brassica) <i>Acidovorax citrulli</i> and <i>P. syringae</i> pv. <i>lachrymanas</i> (on cucurbits) <i>P. syringae</i> pv. <i>maculicola</i> , <i>P. viridiflava</i> , <i>P. cichorii</i> (on Solanaceae or Brassica)
<b>Viroid/PCR</b>	Potato spindle tuber viroid, Tomato chlorotic dwarf viroid, Pepper chat fruit viroid, Tomato apical stunt viroid, Tomato planta macho viroid and Columnea latent viroid (on Solanaceae)
<b>Fungi/Culture</b>	<i>Leptosphaeria maculans</i> (on Brassica) <i>Didymella bryoniae</i> (on cucurbits)





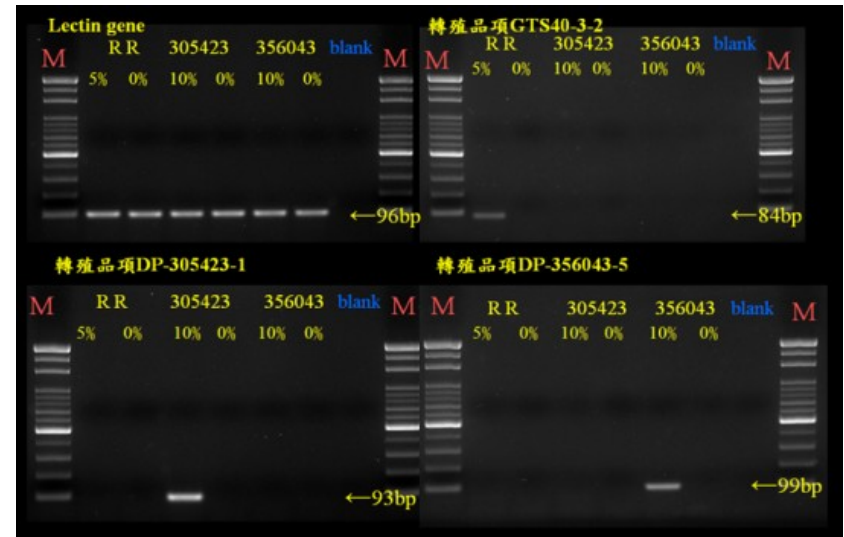


# Field inspection and sampling for GMO monitoring



# In-lab operating procedures

## ■ GM crop monitoring

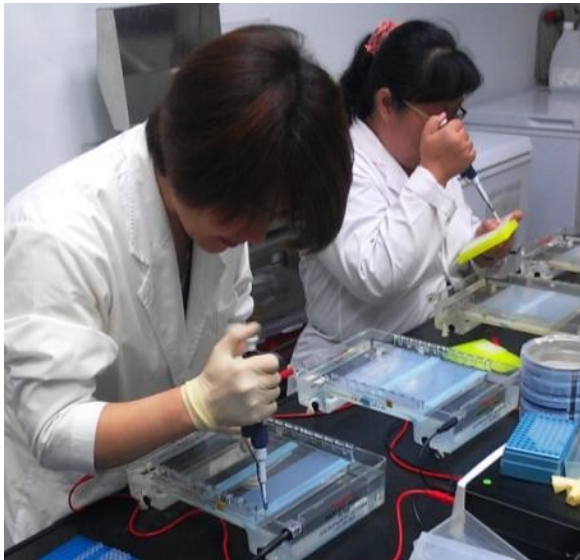






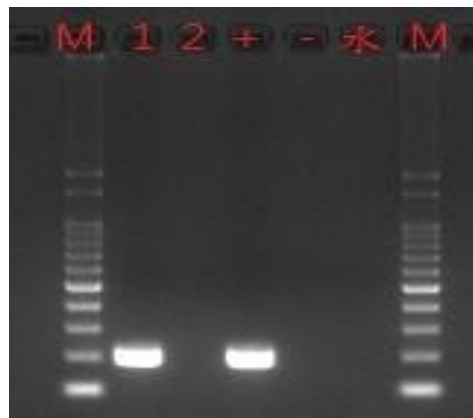
# Achievements of GM crop monitoring

- ✓ The TAF lab carry out random inspections of seeds and seedlings for domestic GM crop monitoring. Approximately **2,500 ha. of papaya** cultivation area, **19,000 ha. of field corn** cultivation area, and **4,000 ha. of soybean** cultivation area in Taiwan are under monitoring.



# In-lab operating procedures

## Plant pathogen detection



# Achievements of plant pathogen detection

- ✓ Taking **watermelon** as an example, each watermelon seed is about **NTD 0.8** (depending on the variety). It is estimated that the export output value of the tested watermelon seed lots is **more than NTD 112 million**.

Number of plant pathogen detection cases in TAF lab

Year	Samples
2013	31
2014	148
2015	156
2016	233
2017	358
2018	464
2019	502
2020	940
2021	692
2022	1,681
<b>Total</b>	<b>5,138</b>

Pathogen		Samples						Total
		2017	2018	2019	2020	2021	2022	
Bacteria	Aac	123	143	84	160	40	168	718
	Xcc	10	32	23	25	18	15	123
	Xcv (Xe, Xv, Xp, Xg)	9	31	18	5	44	16	123
	Pst		1	2	1		1	5
	Rs		1		2	6	12	21
	Ecc			5	4		4	9
	Xcr			11		2		13
	Pv					5	8	5
	Psm					5	11	5
	Cmm						1	1
Virus	CGMMV	55	71	94	184	70	185	659
	TMV	5	1	12	4	10	6	38
	ToMV	2		1	1	21	2	27
	ZYMV	7	9	19	9	2	4	50
	CMV	10	7	33	32	17	205	304
	CymMV & ORSV	39			22			61
	SqMV		8	29	29	17	17	100
	WSMoV		1	5	9	3	3	21
	PMMoV			8	9	14	9	40
	TMGMV			5	5		4	10
	ToBRFV			23	52	124	310	509
	ToRSV			8	15		6	23
	TRSV			2	3		2	5
	PSbMV				1			1
	ToMMV				1	23	114	24
	PepMV				4	2	6	6
	TSWV						12	12
INSV						6	6	
Viroid	viroids on <i>Solanaceae</i>	89	145	89	345	245	531	1444
Fungi	<i>Didymella bryoniae</i>	9	9	19	9	14	6	66
	<i>Letosphaeria maculans</i>		5	12	9	10	17	53
<b>Total</b>		<b>358</b>	<b>464</b>	<b>502</b>	<b>940</b>	<b>692</b>	<b>1681</b>	<b>4637</b>

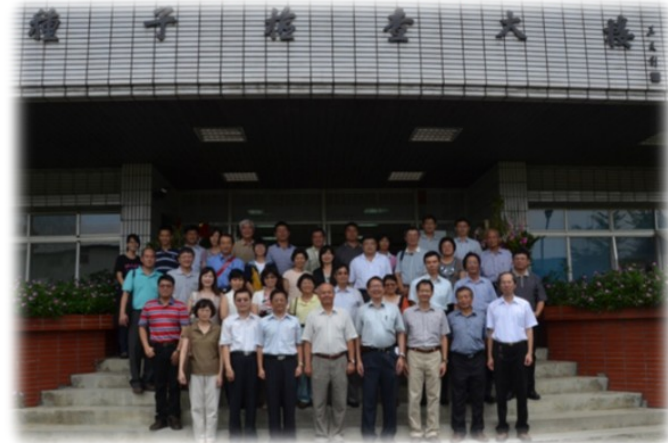






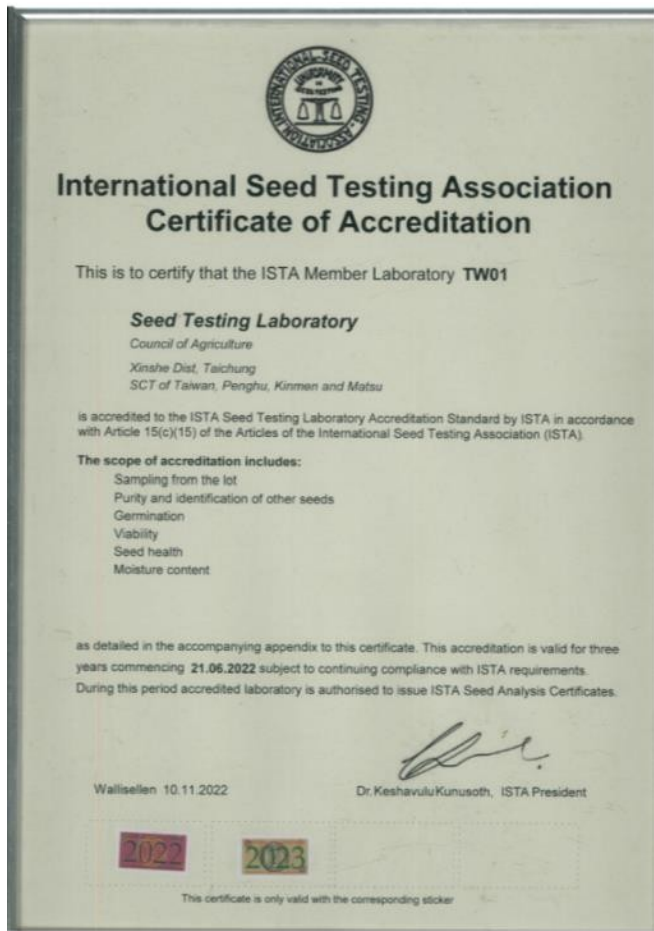
# ISTA accredited Laboratory

- In order to ensure the seed quality for crop propagation and marketing, Taiwan's official seed testing laboratory was set up in 1959.
- Transferred to TSIPS in 2012.

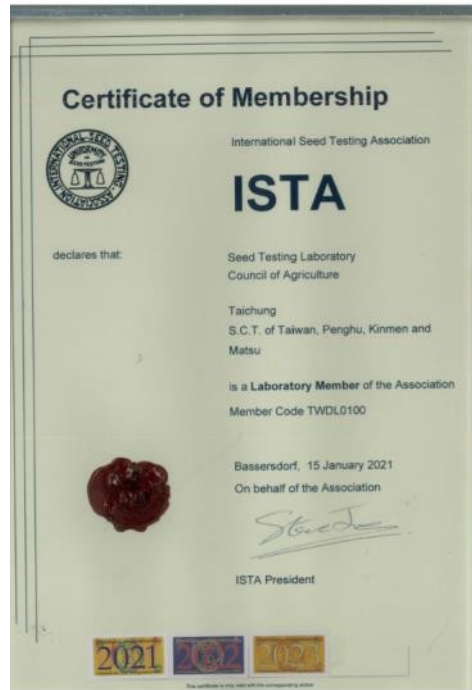




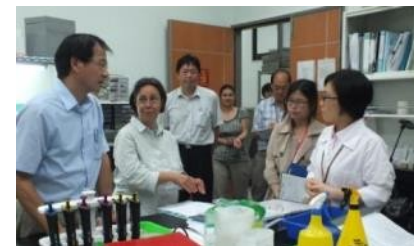
# Taiwan's Only ISTA Accredited Lab Member



ISTA certificate of accredited laboratory

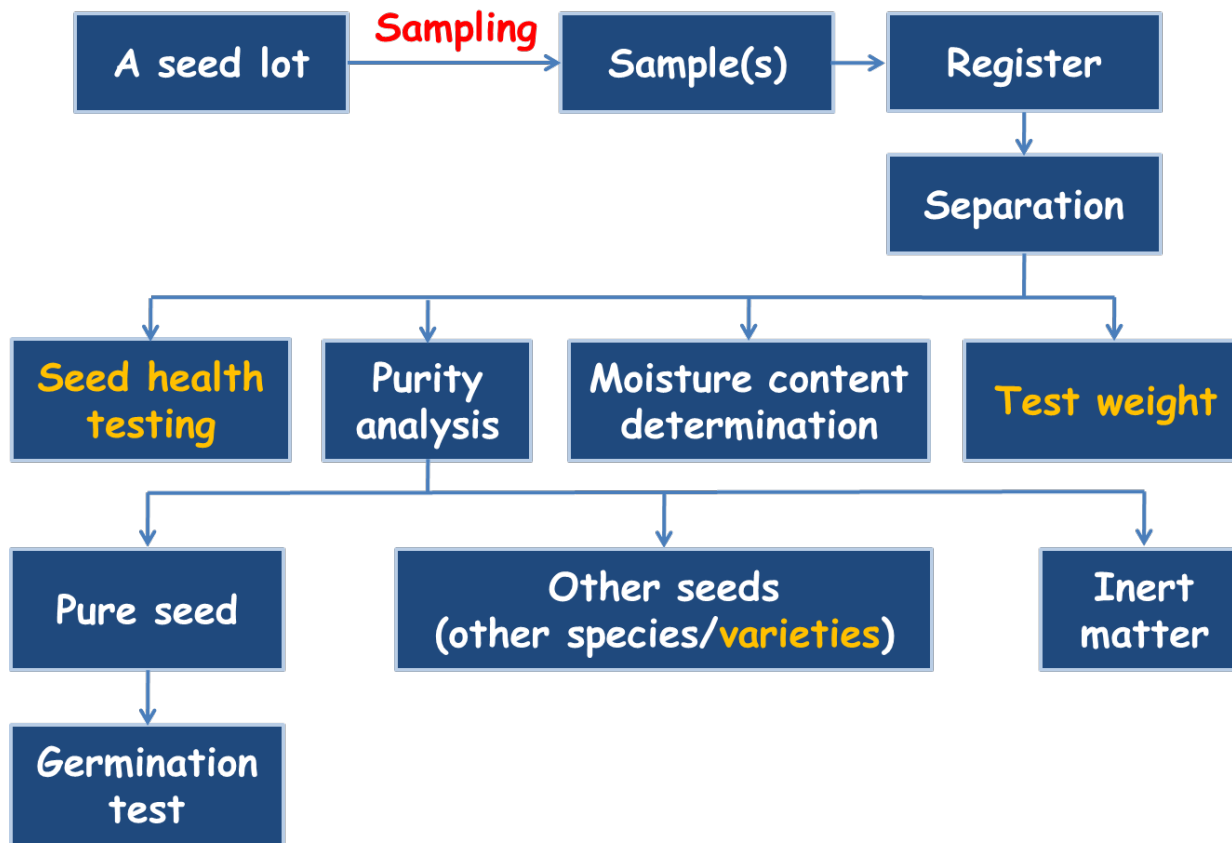


ISTA certificate of laboratory member



# International Rules for Seed Testing

## Seed Testing Chart





# Current Scope of Accreditation

<b>Sampling from the lot</b>	grasses; cereals; small legumes; pulses; vegetables, spices, herbs and medicinal species; tree and shrub species; flower species; other agricultural crops
<b>Moisture content</b>	constant oven method: fine grinding; no grinding; coarse grinding; cutting moisture meter
<b>Purity and identification of other seeds</b>	cereals; pulses; vegetables, spices, herbs and medicinal species; tree and shrub species; flower species; other agricultural crops
<b>Germination</b>	cereals; pulses; vegetables, spices, herbs and medicinal species; tree and shrub species; flower species; other agricultural crops
<b>Seed health</b>	7-004 <i>Leptosphaeria maculans</i> on Brassica 7-019a <i>Xanthomonas</i> on Brassica 7-026 Squash mosaic, Cucumber green mottle mosaic and Melon necrotic spot virus in Cucurbits

# Issuing ISTA seed testing certificates



**ISTA**  
ORANGE INTERNATIONAL SEED LOT CERTIFICATE  
BULLETIN INTERNATIONAL ORANGE DE LOT DE SEMENCES  
INTERNATIONALER ORANGE-BERICHT ÜBER EINE SAATGUTPARTIE

(See back - Voir au verso - Rückseite beachten)

Stamp of Laboratory  
Cachet du Laboratoire  
Stempel des Prüfbüros

STATED BY APPLICANT - INFORMATIONS DU REQUÉRANT - ANGABEN DES ANTRAGSTELLERS  
Without responsibility of the Laboratory - Sans responsabilité du Laboratoire - Ohne Verantwortung der Prüfstelle

Name of applicant  
Nom du requérant  
Name des Antragstellers

Species, cultivar, category, weight of lot etc.  
Espèces, cultivars, catégories, poids du lot, etc.  
Art, Sorte, Kategorie, Gewicht der Partie usw.

INFORMATION - INFORMATIONS - ANGABEN

Issuing and receiving laboratory  
Laboratoire d'essai qui délivre le bulletin  
Laboratoire emittent und empfangende Prüfstelle

Sampling by  
Echantillonnage par  
Probationen durch

Make of lot  
Matière de lot  
Gehalt der Partie

Size of lot  
Poids du lot  
Menge der Partie

Name of Certificate  
Nom du Bulletin  
Name des Berichts

Number of containers  
Nombre de contenants  
Anzahl der Behälter

Date of sampling  
Date d'échantillonnage effectué le  
Datum der Entnahme

How sample received  
Comment échantillon reçu de  
Ursprungsort der Probe

How lot conserved  
Comment conservé  
Umsatz der Probe

How sample  
Comment échantillon  
Umsatz der Probe

ANALYSIS RESULTS - RESULTATS DE L'ANALYSE - UNTERSUCHUNGSERGEBNISSE

SPECIES - ESPÈCE - ART (Scientific name - Nom scientifique - wissenschaftlicher Name)

PURITY - PURETÉ - REINHEIT	GERMINATION - KEIMFÄHIGKEIT										
	% Minors % des mineurs	% of seeds % des graines	Number of days Nombre de jours	Normal seedlings Normaux Keimlinge	Hard seeds Graines dures	Soft seeds Graines molles	Abnormal seedlings Anormaux Keimlinge	Dead seeds Graines mortes	Other seeds Autres graines	% of seeds % des graines	% of seeds % des graines
Pure seeds Semences pures	Minor mineurs	Major maiores	Other plants Autres plantes	Normal normaux	Hard dures	Soft molles	Abnormal anormaux	Dead mortes	Other autres	Other autres	Other autres
Other seeds Autres graines	Minor mineurs	Major maiores	Other plants Autres plantes	Normal normaux	Hard dures	Soft molles	Abnormal anormaux	Dead mortes	Other autres	Other autres	Other autres

Kind of seed matter - Nature des matières semées - Art der scheinb. Vermengungen

Other seeds - Semences d'autres plantes - Andere Samen - / Species not tested - Espèces non scientifiques - Arten (wissenschaftliche) Normen

OTHER DETERMINATIONS - AUTRES DÉTERMINATIONS - WEITERE UNTERSUCHUNGSERGEBNISSE

(See also additional observations on back - Voir aussi observations complémentaires au verso - Siehe zusätzliche Bemerkungen auf der Rückseite)

Reg. No. 00809825  
Reg.-Nr.

**ORANGE International Seed Lot Certificate**

**ISTA**  
BLUE INTERNATIONAL SEED SAMPLE CERTIFICATE  
BULLETIN INTERNATIONAL BLEU D'ÉCHANTILLON DE SEMENCES  
INTERNATIONALER BLAU-BERICHT ÜBER EINE SAATGUTPROBE

(See back - Voir au verso - Rückseite beachten)

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Cachet du Laboratoire  
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Nom du requérant  
Name des Antragstellers

Species, cultivar, material, etc.  
Espèces, cultivars, matériels, etc.  
Art, Cultivar, Material, usw.

Weight of lot  
Poids du lot  
Gewicht der Probe

Number of containers  
Nombre de contenants  
Anzahl Behälter

Date of sampling  
Date d'échantillonnage effectué le  
Datum der Entnahme

INFORMATION - INFORMATIONS - ANGABEN

Issuing laboratory  
Laboratoire qui délivre le bulletin  
Berichtende Prüfstelle

Name of Certificate  
Nom du Bulletin  
Name des Berichts

How sample received  
Comment échantillon reçu de  
Ursprungsort der Probe

How lot conserved  
Comment conservé  
Umsatz der Probe

How sample  
Comment échantillon  
Umsatz der Probe

ANALYSIS RESULTS - RESULTATS DE L'ANALYSE - UNTERSUCHUNGSERGEBNISSE

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Reg. No. 00645035  
Reg.-Nr.

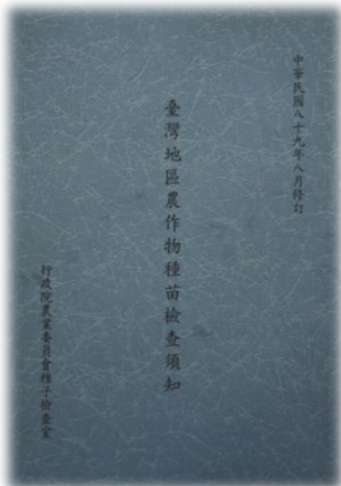
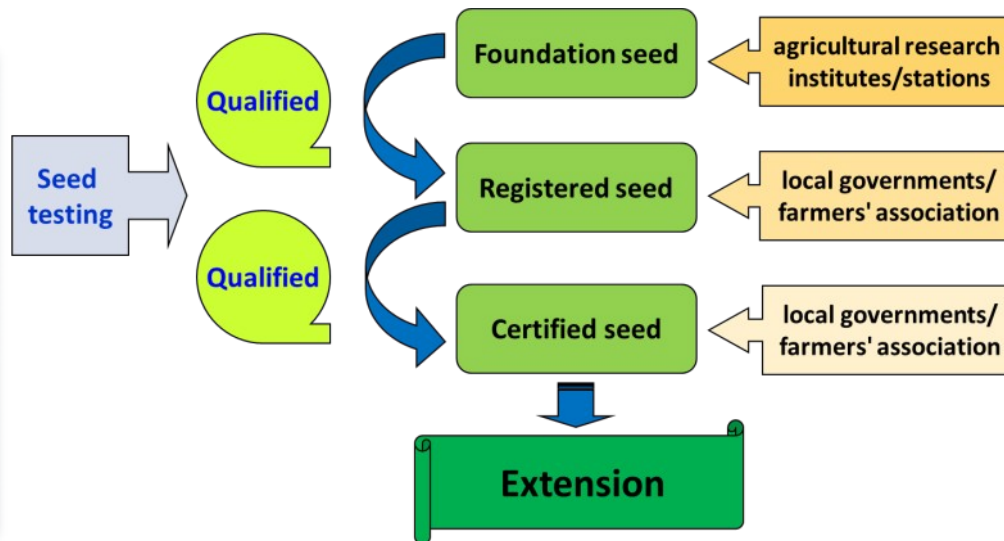
**BLUE International Seed Sample Certificate**












# Seed testing for domestic seeds

- According to 'Taiwan Crop Seed Testing Directions', the lab implements field inspection and seed quality testing for Good Seed Propagation on paddy rice, maize, sorghum, peanut and soybean.
- According to 'The Plant Variety and Plant Seed Act', the lab implements seed quality testing for domestic marketing seeds.

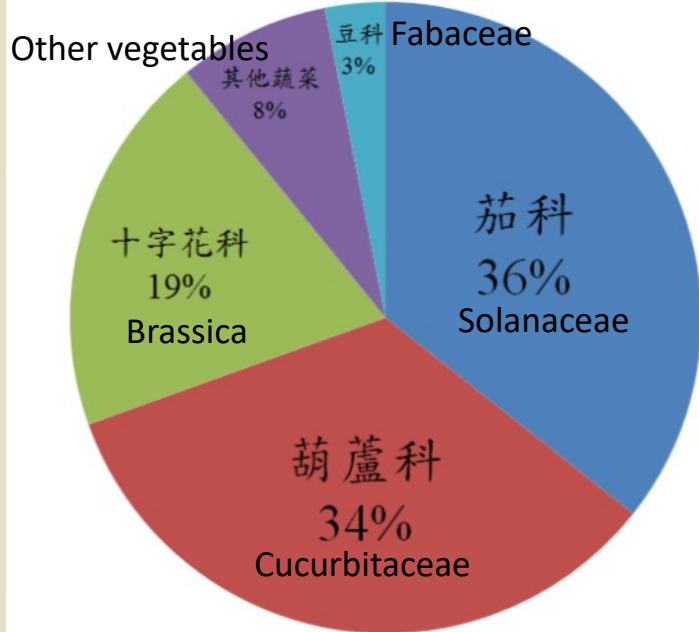


# Members in ISTA TCOM

TCOM	Abbr.	
Advanced Technologies Committee	ATC	 Dr. Wen-Shi Wu, NTU (retired)
Bulking and Sampling Committee	BSC	
Flower Seed Testing Committee	FST	
Forest Tree and Shrub Seed Committee	FTS	
Germination Committee	GER	 Dr. Wen-Ju Yang, NTU
Moisture Committee	MOI	
Nomenclature Committee	NOM	 Dr. Wen-Hsin Chung, NCHU
Proficiency Test Committee	PTC	
Purity Committee	PUR	 Mr. Shih-Min Su, TSIPS
Rules Committee	RUL	
Seed Health Committee	SHC	 Dr. Bo-Jein Kuo, NCHU
Statistics Committee	STA	
Seed Storage Committee	STO	 Dr. Kae-Kang Hwu, NTU (retired)
Tetrazolium Committee	TEZ	
Variety Committee	VAR	 Mr. I-Cheng Chen, TSIPS
Vigour Committee	VIG	
GMO Committee	GMO	
Seed Science Advisory Group	SSAG	



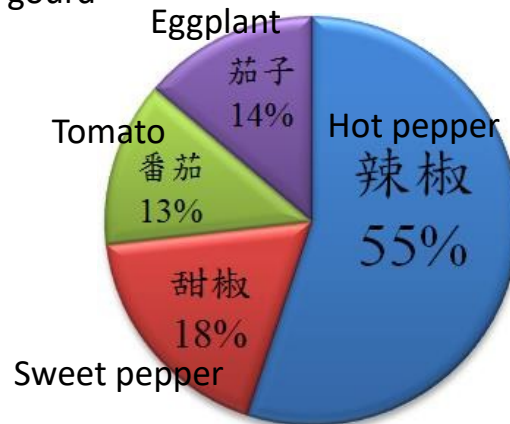
# Achievements of export seed testing



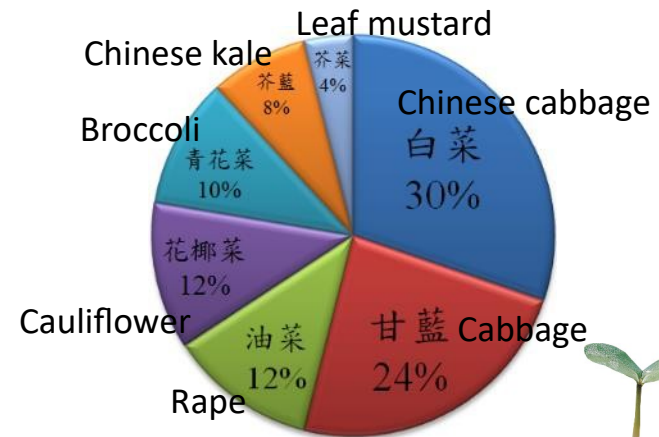
✓ It is estimated that the amount of exported seeds inspected by ISTA accredited lab could reach 25,000 kg per year and that boosted Taiwan seed export value to NTD 90 millions.



Cucurbitaceae



Solanaceae



Brassica





# Achievements of domestic seed testing

- ✓ The qualified rice seeds can be used for domestic rice cultivation area of 125,000 ha., accounting for approximately 50% of Taiwan's rice field area.





# Development of new tech for seed testing

## ✓ Application of Image Recognition technology for purity analysis on Paddy Seed (Ciao-Yun Syu *et al.*)

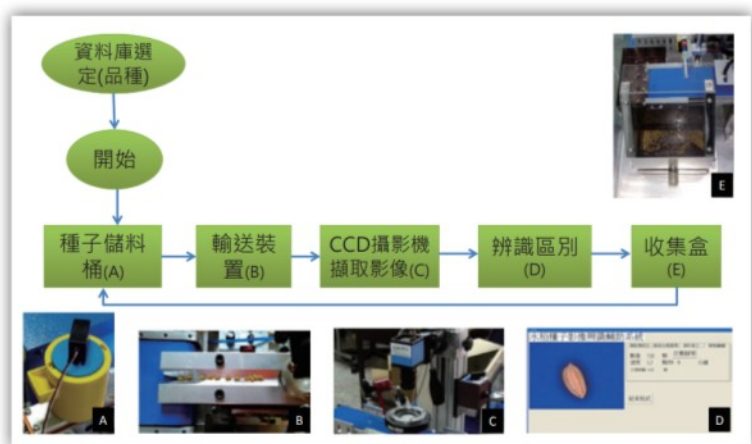
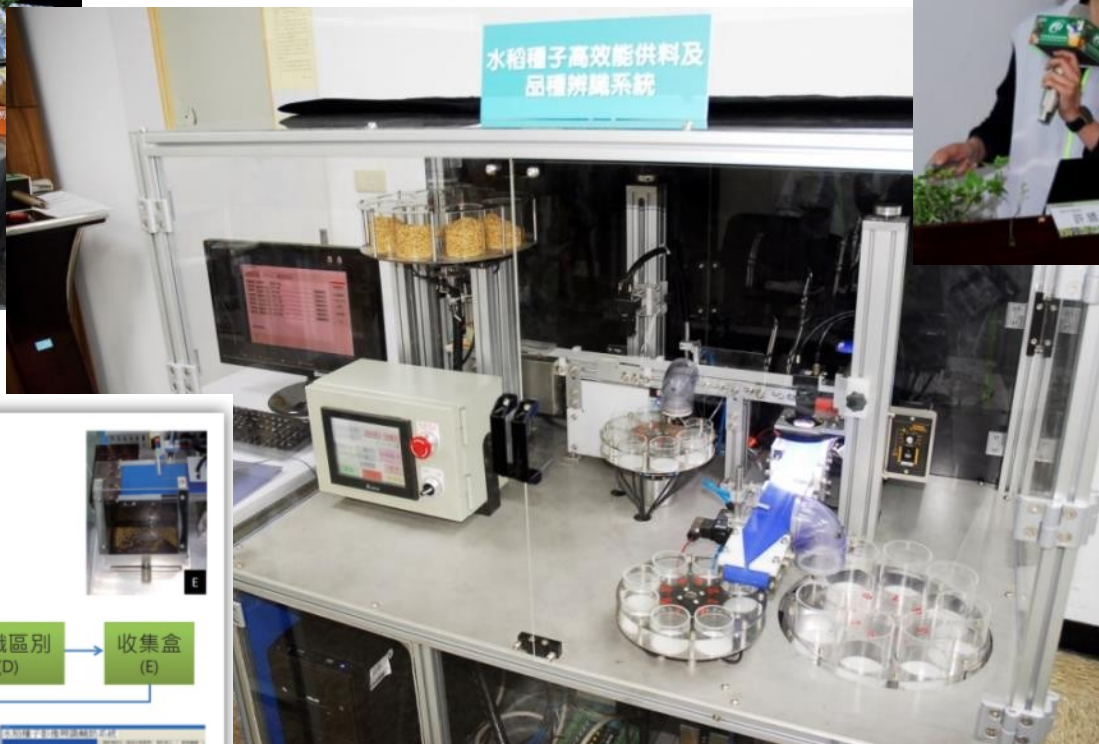


圖 2. 系統操作流程圖



# Development of new tech for seed testing

## ✓ Application of Image Recognition System on Paddy Seed Germination Test (I-Cheng Chen *et al.*)

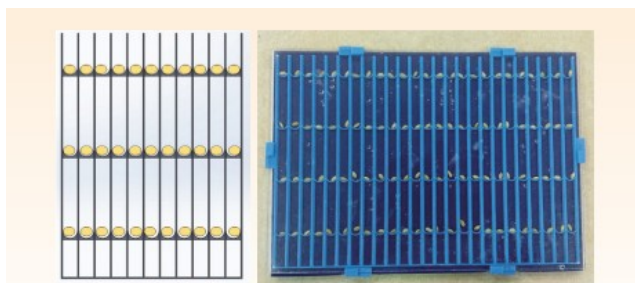


圖 1. 以 3D 列印技術製作之種子發芽容器

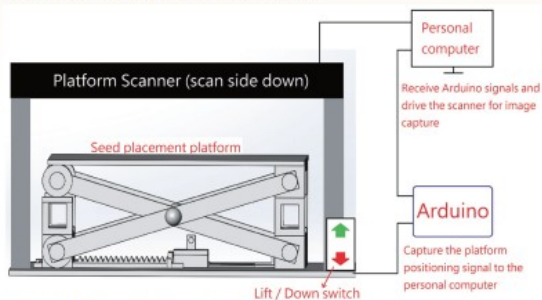


圖 2. 水稻幼苗影像辨識系統架構

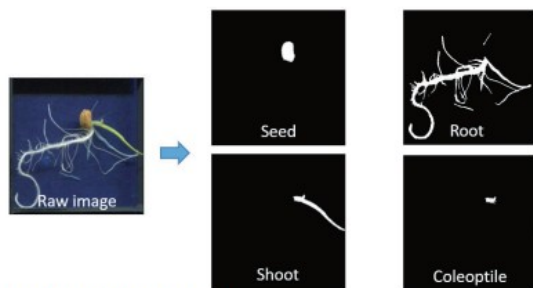


圖 3. 水稻種子幼苗影像分割情形



圖 4. 幼苗側根重疊



圖 5. 幼苗主根繞圈與重疊



圖 6. 水稻幼苗次生根較主根長

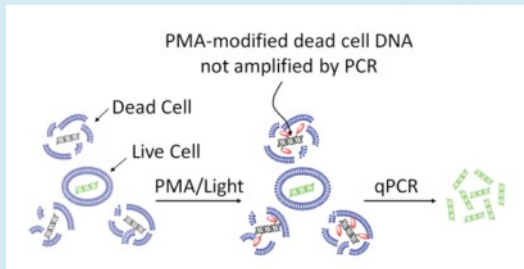


圖 7. 取像環境造成的錯誤



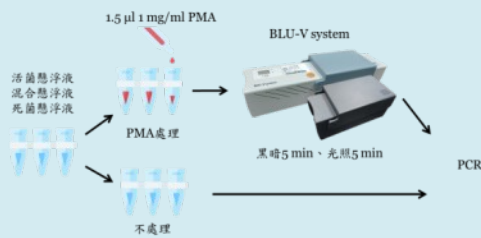
# Development of new tech for seed testing

## ✓ Application of combination of propidium monoazide (PMA) and PCR for bacterial pathogen detection

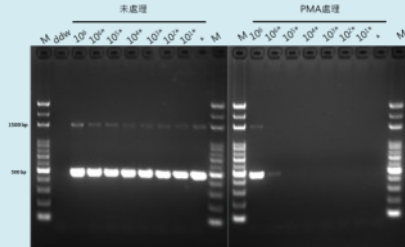


(圖片來源: <http://www.omicsbio.com.tw>)

### PMA搭配PCR檢測效果測試

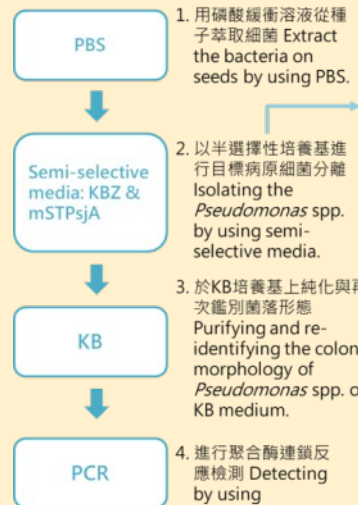


### PMA搭配PCR檢測效果測試-Pv

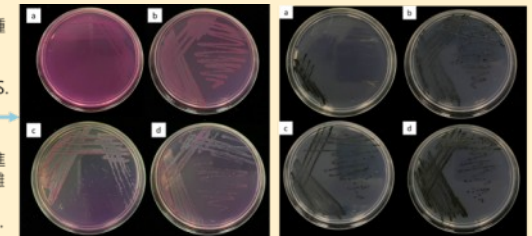


\*表示該處理添加菌懸浮液(10<sup>7</sup> CFU/ml)

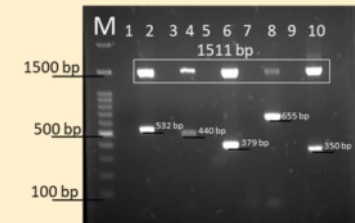
## ✓ Establishment of an integrated operating procedure for detecting five *Pseudomonas* spp. to improve efficiency and to decrease costs



1. 用磷酸緩衝溶液從種子萃取細菌 Extract the bacteria on seeds by using PBS.
2. 以半選擇性培養基進行目標病原細菌分離 Isolating the *Pseudomonas* spp. by using semi-selective media.
3. 於KB培養基上純化與再次鑑別菌落形態 Purifying and re-identifying the colony morphology of *Pseudomonas* spp. on KB medium.
4. 進行聚合酶連鎖反應檢測 Detecting by using polymerase chain reaction.



圖、*Pseudomonas* spp.於半選擇性培養基KBZ上呈粉紅色、小而平坦、邊緣略為透明之圓形菌落(左圖)；在mSTPsjA上呈黑色扁平狀、邊緣略為透明、中央黑色之圓形菌落(右圖)。(a) *P. syringae* pv. *tomato* (b) *P. viridiflava* (c) *P. cichorii* - Pc12621 (d) *P. cichorii* - Pc12682



圖、引子對測試之電泳分析結果。專一性引子對測試：1-2為MM5F/MM5R (532 bp)、3-4為20F/20R (440 bp)、5-6為SfL1/SfR2 (379 bp)、7-8為cflF/cflR (655 bp)、9-10為PalF/PalR (350 bp)。1511 bp為UpBacF/UpBacR廣效性引子對之條帶。1:ddw、2:Pst、3:ddw、4:Pv、5:ddw、6:Pc、7:ddw、8:cPsm、9:ddw、10:cPal

(Shih-Min Su *et al.*)

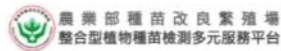






# Keep going ...

- Keep developing seed testing techniques/SOPs for seed industry's need.
- Keep improving efficiency of seed testing service



農業部種苗改良繁殖場  
整合型植物種苗檢測多元服務平台

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WELCOME

歡迎光臨：整合型  
植物種苗檢測  
多元服務平台





**Thank You**