

# GRAFTING VEGETABLE SEEDLINGS FOR SOIL BORNE DISEASE RESISTANCE

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# Grafting Vegetables in the Developing World – A Multiyear Perspective

- Critical component of IPM packages for solanaceous vegetables
  - Eggplant
  - Tomato
- IPM CRSP
  - Bangladesh, Nepal, Philippines, Kenya, Uganda



# Major Soil-borne Diseases of Solanaceous Diseases in the Tropics

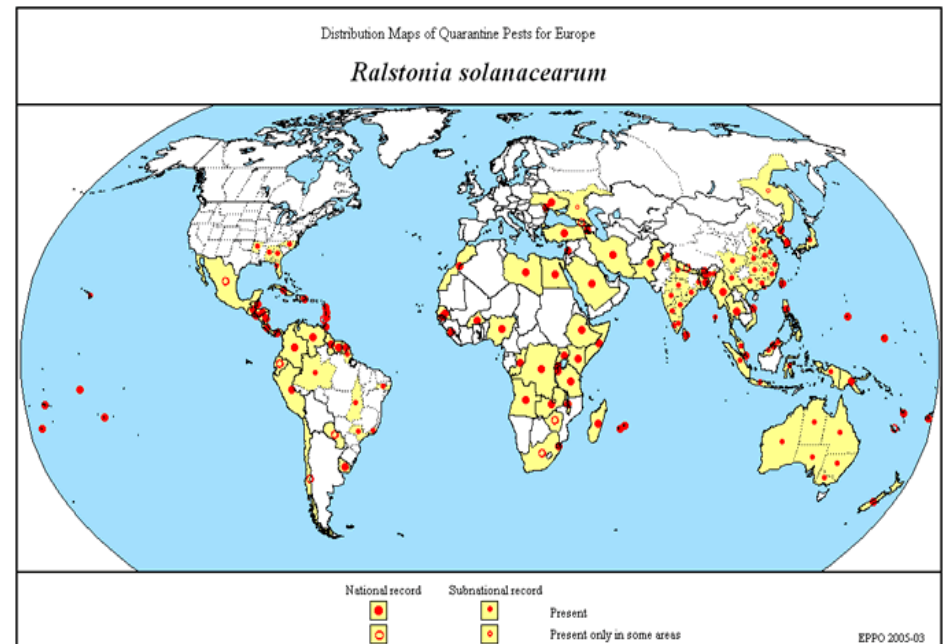
- Bacterial wilt
  - *Ralstonia solanacearum*
  - Widely distributed in tropical and sub-tropical regions
  
- Root knot nematode
  - *Meloidogyne* spp.
  - Also widely distributed





# *Ralstonia solanacearum* species complex

- Infects >450 plant species
- Wide geographic distribution
- 6 Biovars
- 5 Races
- 2 Divisions
  - Asiaticum
  - Americanum



# *Ralstonia solanacearum* - hierarchical classification scheme

<b>Taxonomic level</b>	<b>Nomenclature</b>	<b>Origin</b>
Phylotype	I	Asia
	II	Americas
	III	Africa
	IV	Indonesia
Sequevar	1-23	
Clone	Many	

Proposed by Prior and Fegan (2005) to predict properties of *R. solanacearum*

# Diversity of *R. solanacearum* Race 1 Strains – the Philippines

Province	n <sup>a</sup>	Biovar	ERIC-PCR genotype		Phylotype	Endoglucanase subgroup
			Whole pattern	Band based		
Batangas	1	3	1	B	I	1
	6	3	2	C	I	1
	3	3	3	E	I	4
	20	4	2	A	I	1
Laguna	11	3	1	D	I	1
	1	3	4	G	I	2
Neuva Ecija	4	3	1	D	I	1
	1	4	1	D	I	1
	1	4	1	H	I	1
Quezon	1	3	1	B	I	1
	12	3	1	D	I	1
	1	4	2	A	I	1
	18	4	1	B	I	1
Pangasinan	4	3	1	B	I	1
	1	3	1	D	I	1
	8	3	4	G	I	2
	80	4	1	B	I	1
	1	4	1	D	I	1
	3	4	1	H	I	1
	2	4	1	I	I	1

# Diversity of *R. solanacearum* Race 1 Strains – Bangladesh and Nepal

Location	Phylotype	BV 3	BV 4
<b>Bangladesh</b>			
Jamalpur	I	9	0
Norsindhi	I	3	13
Jessor	I	14	0
Comilla	I	0	12
Bramin Baria	I	0	2
Hat Hazaria	I	5	2
Tangail	I	5	3
Joydebpur	I	0	2
Bogra	I	5	1
<b>Nepal</b>	<b>I</b>	<b>9</b>	<b>0</b>
<b>Total</b>		<b>50</b>	<b>35</b>

# *Ralstonia* Strain Variation in Uganda

District	Geographic region	No. Strains	Biovar
Wakiso (Kabanyolo)	Central	3	3
Mukono	Central	3	3
Kasese	Western	3	3
Jinja	Eastern	2	3
Mbarara	Western	2	3
Lira	Northern	3	3
Masaka	Central	3	3

Strains isolated from soil in tomato fields



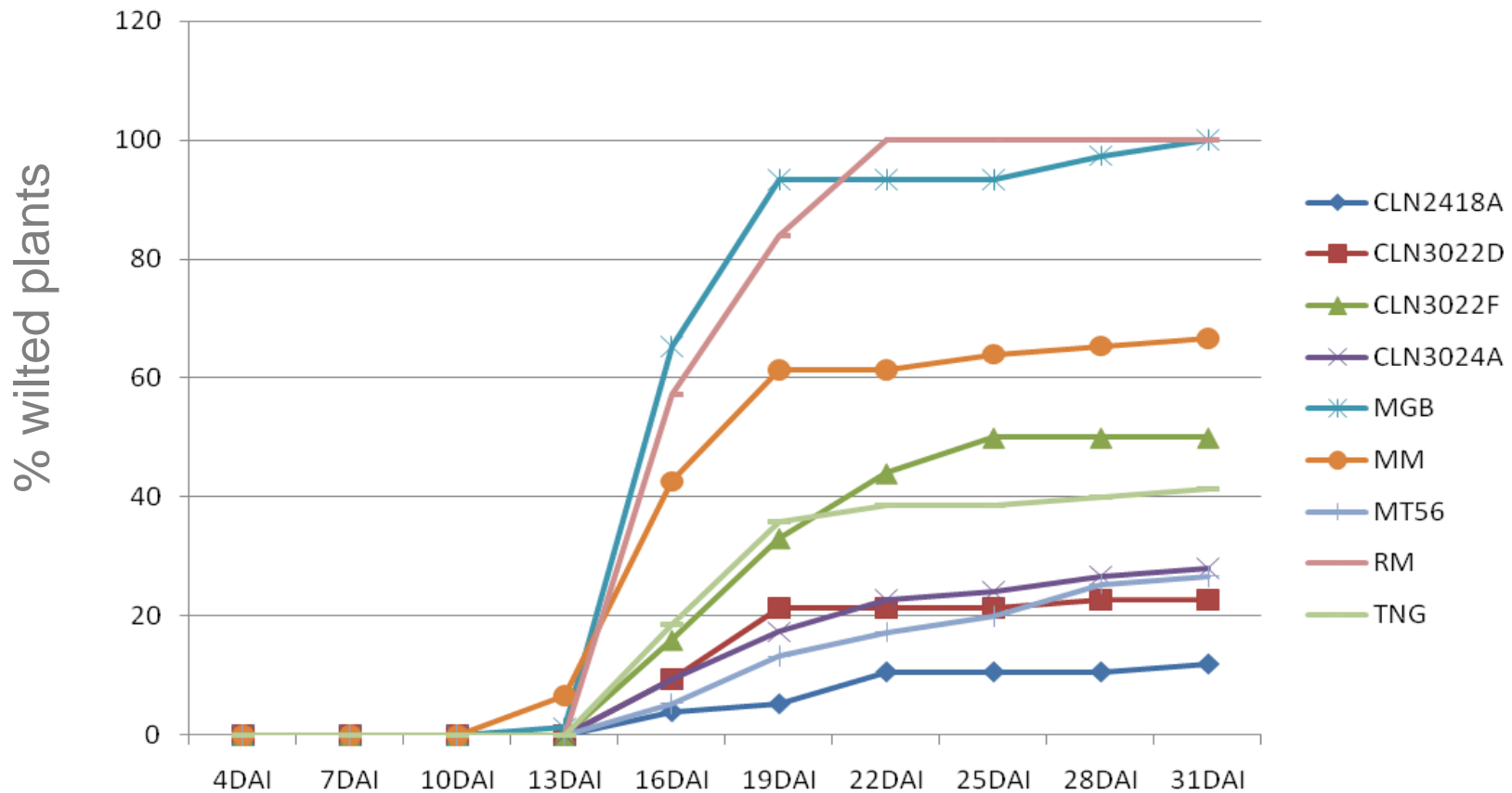
# Virulence of *Ralstonia solanacearum*

- Highly variable – resistance often overcome
  - Significant cultivar x location interactions
- Virulence not associated with phylogenetic groups
  - Pathoprofiles (LeBeau et al Phytopathology 2011)
    - 30 “Core TEP” lines maintained at AVRDC and INRA
    - Not associated with phylotypes
    - 12 core Rs strains representing phylogenetic groups displayed 6 virulence types on Core TEP lines

# Bacterial Wilt-Resistant Materials

- *Solanum sisymbriifolium*
- *S. torvum*
- *S. melongena EG203*
- *S. lycopersicum Hawaii 7996*
- AVRDC lines classified as BW-resistant
  - 12 CLN tomato
  - 4 AVPP chili pepper
  - 2 eggplant
- INRA
  - 5 tomato
  - 8 eggplant
  - 6 pepper
- Bangladesh
  - Eggplant
    - BARI Begun -6, -7, -8
    - Lalteer – 7 varieties
  - Tomato
    - Various
- Uganda
  - MT56

# Response of Tomato Genotypes to *Ralstonia solanacearum* (bv3) - Uganda



TNG- Tengeru 97; MM- Moneymaker; RM- Roma; MGB- Marglobe

# Utilization of Grafting within IPM Packages

- Identification of pathogen complex in a region
- Highly resistant rootstock selection for that region
  - *Solanum sisymbriifolium* (sticky nightshade) – Bangladesh, Nepal
  - *S. melongena* EG203 (eggplant) - Philippines
  - *S. torvum* (turkey berry) - Nepal
  - Tomato MT56 – Uganda, Kenya
- Establishing grafting capability
  - Timing/mechanics
  - Infrastructure
  - Training
- Rainy season IPM packages
  - High tunnels
  - Mulching



95- 99% graft survival



Graft Seedling  
(4-5 leaf stage)

(3 weeks)

(4 weeks)

Seed rootstock  
and scion



Acclimatize

Transplant





# Grafting Tomato in Nepal



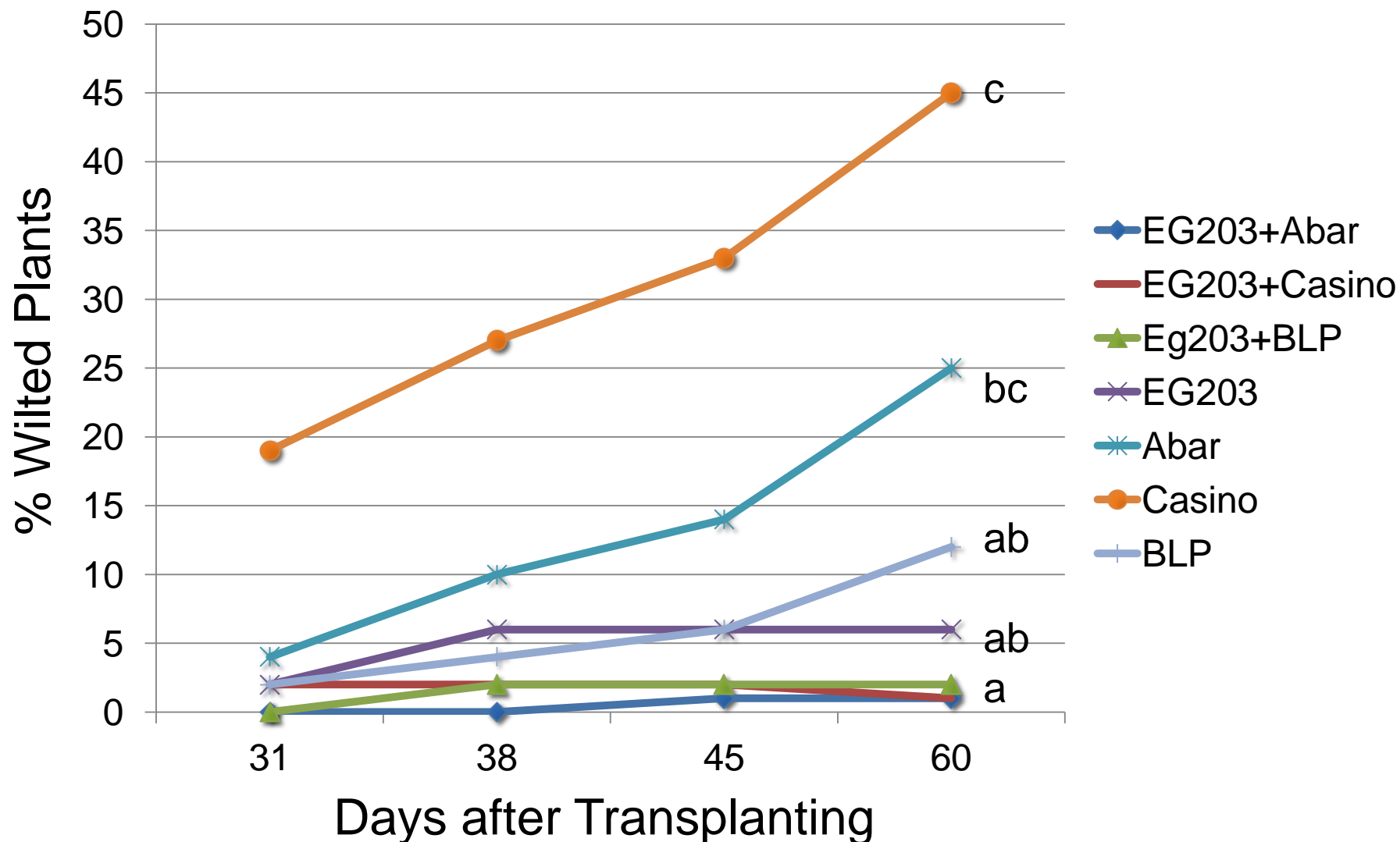
*Solanum torvum* rootstock



# Management of Bacterial Wilt Using Grafted Eggplant



# Bacterial Wilt of Grafted and Nongrafted Eggplant – the Philippines



# Marketable and Total Yield of Grafted and Non-Grafted Eggplant\*

Cultivar	Marketable Yield (Kg)	Total Yield (Kg)
EG203+ Casino	1.9 a	2.8 a
Casino	1.5 a	3.4 a



\* In absence of bacterial wilt

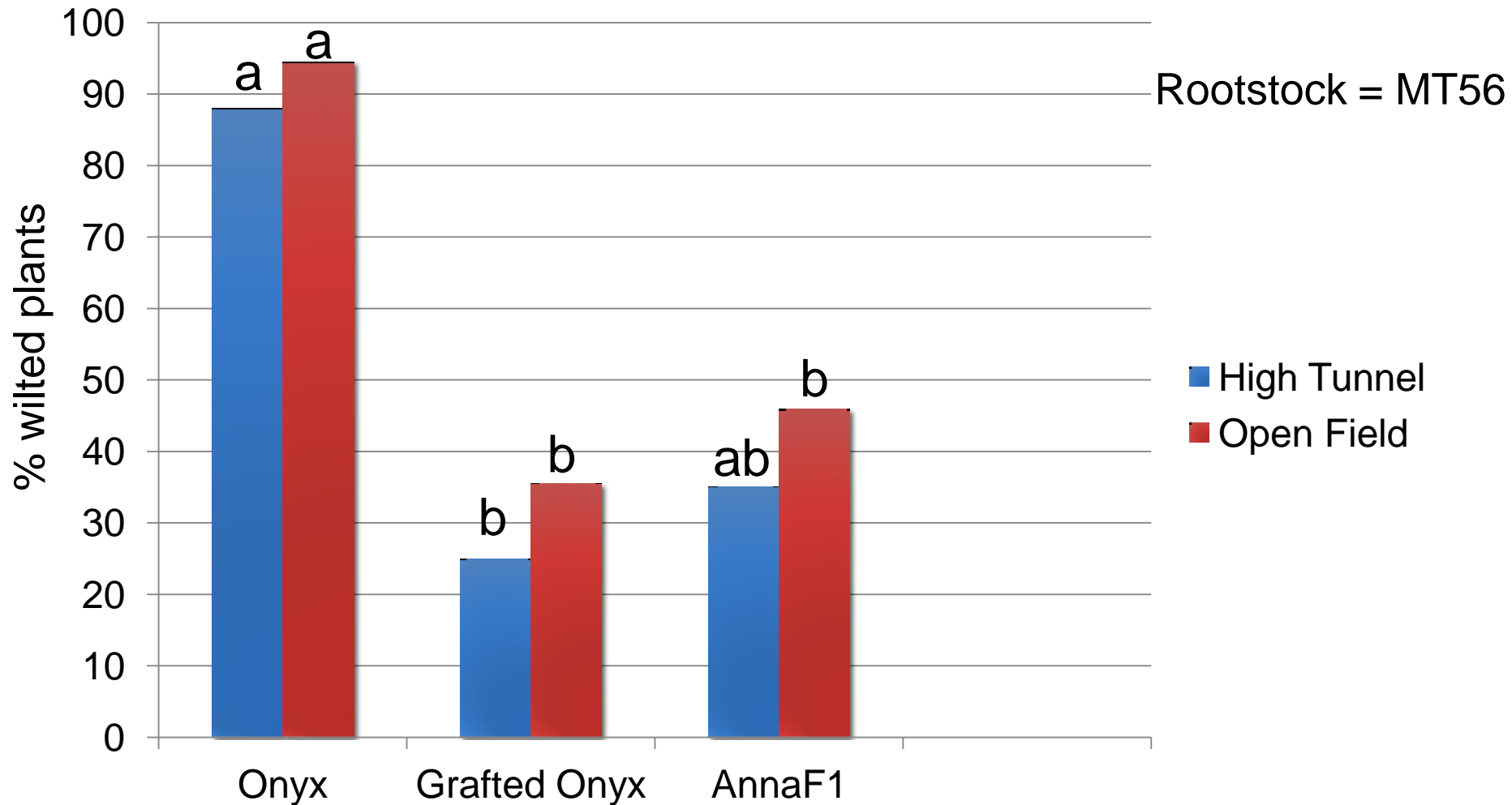


# Benefits of Eggplant Grafting - Bangladesh

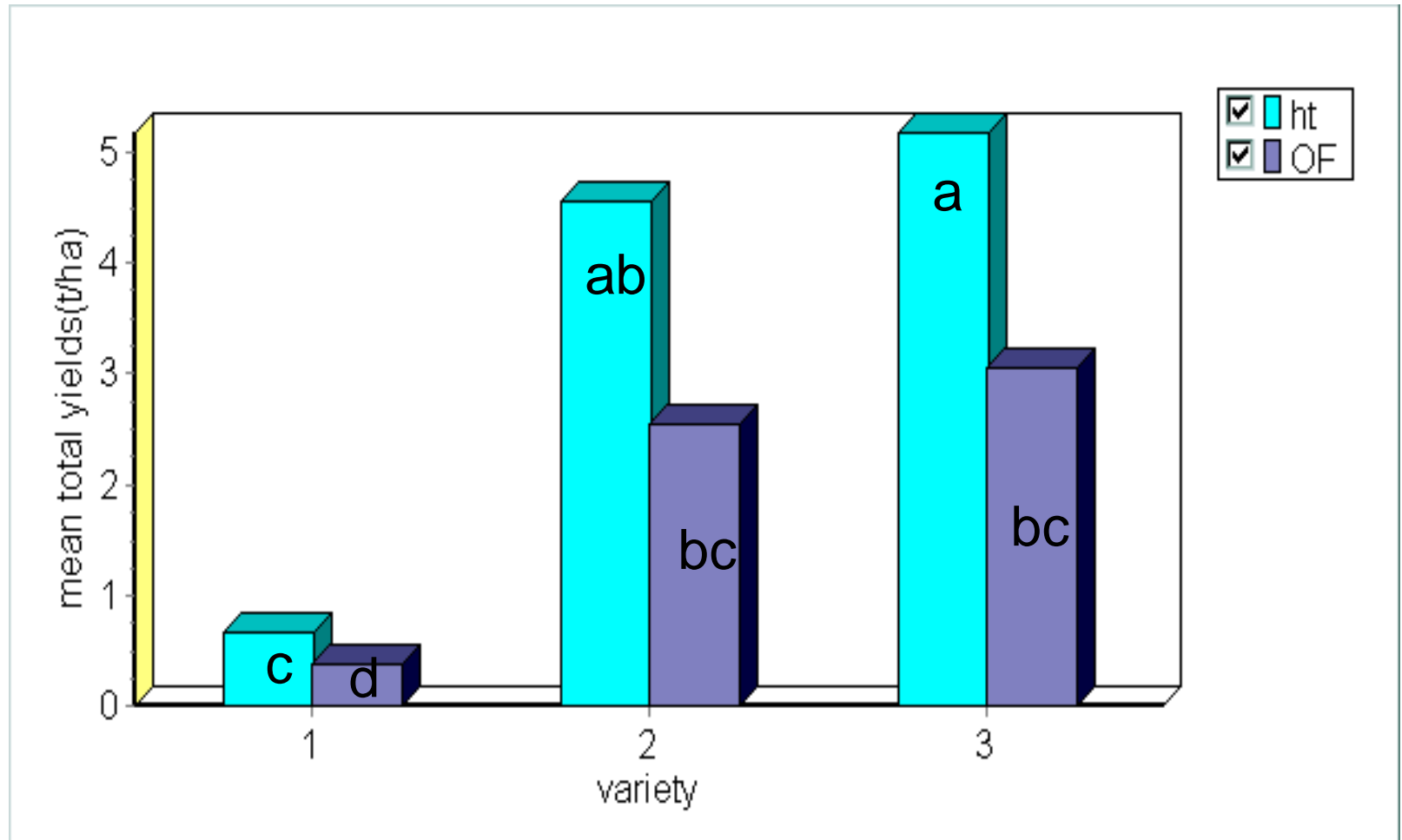
Location (Jessore)	Rootstock/ Scion	Dead plants (%)	Harvest time (days)	Yield (T/ha)	Net Income (US\$/ha)
Naoda-gagram	S. s./ Chega	8.1 c*	89 a	33a (254%)	2271 (299%)
	Chega	31.6 a	60 b	13b	760
Gaidghat	S.s./ Chega	7.5 c*	77 b	31a (282%)	2032 (398%)
	Chega	27.3 a	55 c	11 c	510

\*Primarily Phoma

# Management of Bacterial Wilt by Tomato Grafting - Kenya



# Effect of Grafting and High Tunnels on Tomato Yield -Kenya



1=Ungrafted Onyx, 2=Onyx grafted, 3=Ana F1 Hybrid



# Managing Tomato RKN by Grafting-Nepal

Pokhara (Kaski District)

Treatment	Yield (Kg/15 plants)
<i>S. sisymbriifolium</i> + Srijana	43.6 a
Srijana	15.8 b

Syanjga District

Treatment	Yield (Kg/10 plants)
<i>S. sisymbriifolium</i> + Srijana	92.6 a
Srijana	67.8 b



# Grafting as an Entrepreneurial Activity

- Bangladesh
  - Approx. 2500 BDT = \$30 to set up grafting
  - 300 grafts/person/day
  - 2 BDT/seedling = \$7.50/day
    - 76.5% of Bangladesh population lives on under \$2/day\*
    - 57.6% under \$2/day in Nepal
- Women usually spend earned income on food, clothing and school supplies



Bangladesh



Nepal

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