VALUE CHAIN OF MUNGBEAN

S. SHANMUGASUNDARAM

"The farmer is our client; it is he whom we must serve. Any other objective is trivial compared with our aim to improve the well being of the rural population, and to strengthen agricultural production"

Robert F. Chandler, 1975

World Mungbean Area and Production (1995)

	Area ('000 ha)	Production ('000 t)	Yield t/ha)
World total	5,720	2,924	0.5
South Asia	4,290 (75%)	1,696 (58%)	0.5

Legumes Major Protein Source

- For vegetarians
- For rural poor
- Asia- Mungbean
- Africa- Cowpea
- Latin America- Phaseolus beans

Protein

	Plant source	Animal source
Developing	80%	20%
Developed	43.4%	56.4%

Legumes

- Improve the income
- Diversify the cropping system
- Sustain productivity of farm land

Legumes fix Nitrogen

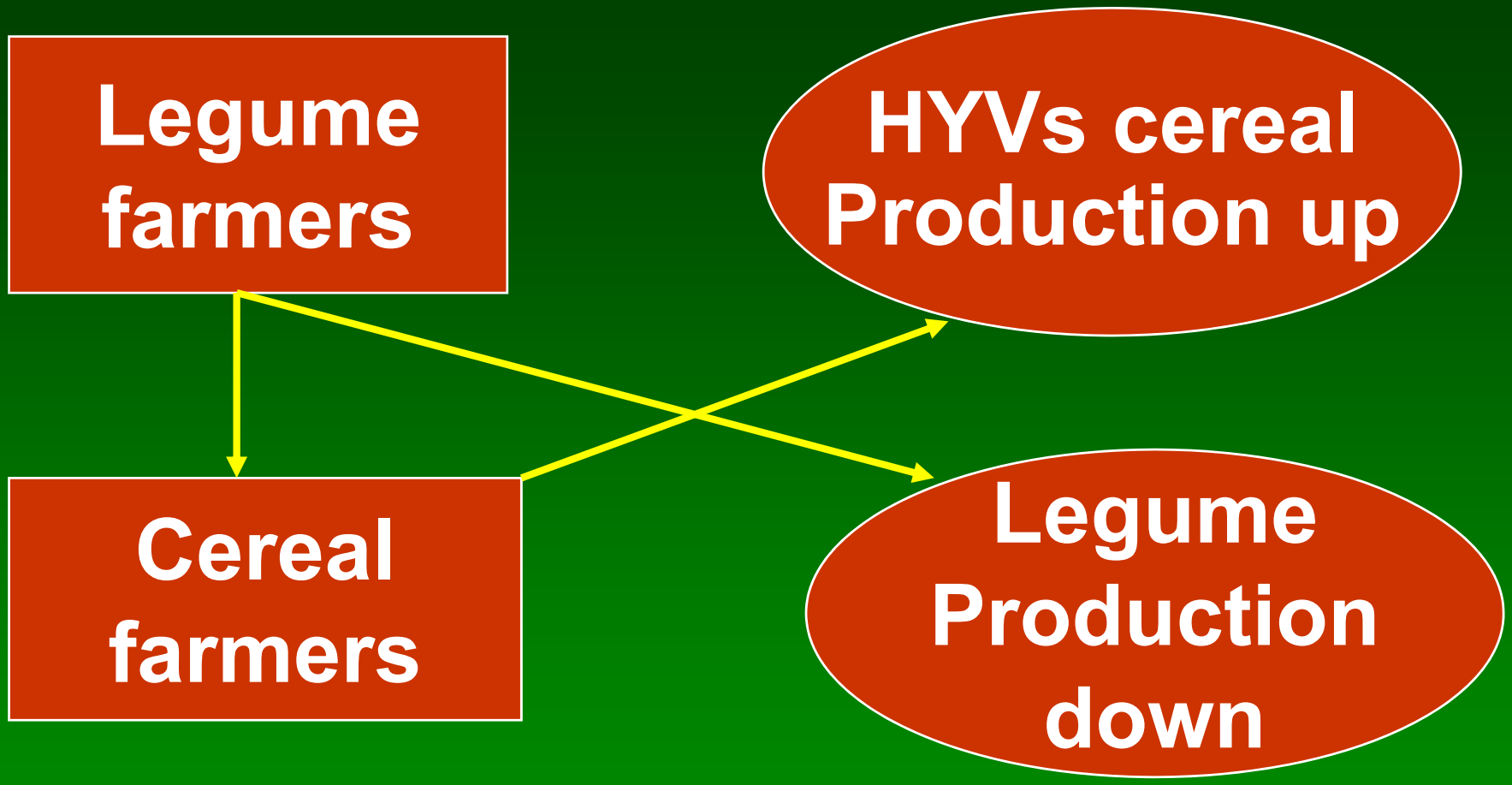
Rhizobium
+
Legume

Atmospheric N

Symbosis

Root
nodules

GREEN REVOLUTION



Botanical Aspects

1. Taxonomy
2. Related species
3. Key for identification
4. Origin
5. Description
6. Implications

Legume crops

Family: Leguminosae

Sub-family: Papilionoidae

Taxonomy

Kingdom	Plant kingdom
Division	Spermatophyta
Subdivision	Angiospermae
Class	Dicotyledonea
Order	Leguminosae
Family	Papilionoideae
Tribe	Phaseoleae
Genus	Vigna
Subgenus	Ceratotropis
Species	*radiata*
Variety	*radiata*

Vigna radiata (L.) Wilczek	Mungbean, Moong, Greengram, Golden gram
Vigna trilobata (L.) Verdc.	Phillipesare bean, Jungli bean
Vigna umbellata (Thumb.) Ohwi and Ohashi	Rice bean, red bean
Vigna radiata var. *sublobata* (Roxb.) Verdc.	Wild progenitor of mungbean

Related Species

Species	Common names
Vigna aconitifolia (Jacq.) Maréchal	Moth bean, mat bean
Vigna angularis (Willd.) Ohwi and Ohashi	Adzuki bean, red bean
Vigna mungo (L.) Hepper	Urd, mash, blackgram, Mungbean

Key for Identification

1. Germination epigeal and petiole of primary leaves short
   - a. Hilum not concave — *V. radiata* (mungbean)
   - b. Hilum concave — *V. mungo* (blackgram)
2. Germination hypogeal and petiole of primary leaves long
   - a. Hilum not concave — *V. angulalris* (adzuki bean)
   - b. Hilum concave — *V. umbellata* (rice bean)

Mungbean - Origin

India

Indo-Burmese Region

Central Asian Region –
Primary Gene Center

Key Sector Problem

Low Productivity Of Mungbean

RESEARCHTO DEVELOP IMPROVED VARIETIES

1. Constraints to mungbean production
2. Breeding objectives
3. Germplasm resources
4. Innovative strategies
5. Hybridization techniques
6. Breeding methods
7. Breeding in different countries
8. AVRDC
9. Implications

Constraints to Mungbean production

- Low yield
- Unstable yield
- Non-uniform maturity
- Non-responsive to inputs
- Shattering
- Susceptibility to MYMV, PM, CLS, bean flies, pod borer and bruchids
- Long maturity duration

Goal

- To improve the efficiency of vegetable production in cereal-based system by developing improved materials and technology which will enhance income, improve health, broaden knowledge base and sustain environment

Major Goal of AVRDC Mungbean Programs ("SHE" Program)

1. **S**tability; multiple resistances to biotic and abiotic stresses
2. **H**igh yielding; high harvest index
3. **E**arliness; fitness to multi-cropping
4. **E**asy harvest; synchronous flowering, podding above canopy

Main Objectives of Mungbean Research at AVRDC

- High yield with stability
- Vigorous early vegetative growth with higher harvest index
- Multiple resistance to diseases and insect pests
- Drought & cold tolerant
- Alleviation of harvest problem
- Better nutritional quantity & quality

Specific Objectives

- Stable yield
- High yield
- Earliness
- Resistance to MYMV, PM, CLS, beanfly, pod borer, bruchids, shattering
- Synchronous maturity
- Reduced sensitivity to photothermal variation

Materials Identified for Breeding

Entry	Origin	Trait
V 3388	USA	HY
V 3404	Thailand	Pods/plant
V 1789	India	Pod length, 100 seed weight
V 2184	Philippines	Earliness
V 1948	Philippines	No. of seeds/pod
V 3092	India	No. of seeds/pod

Breeding for High Yield

1. Traditional Approach
2. Biometrical Approach
3. Physiologic Approach

Innovative Strategies

Plant type

Source – Sink

Yield

Yield

Plant type
Plant height
No. of branches/plant
Pods/plant
Seeds/pod
Seed weight
Days to flower
Days to maturity

Ideal Mungbean Plant Type

1. Short internode length
2. Small, erect leaves with minimum phototropic response
3. No branches
4. All pod-bearing racemes to have their own "source"
5. The petioles of all trifoliate leaves to meet the main stem at small angles
6. Most pods are positioned near the top of the plant

Multi-Location Trial

1. Varieties
2. Locations
3. Plot size
4. Replication
5. Data collection

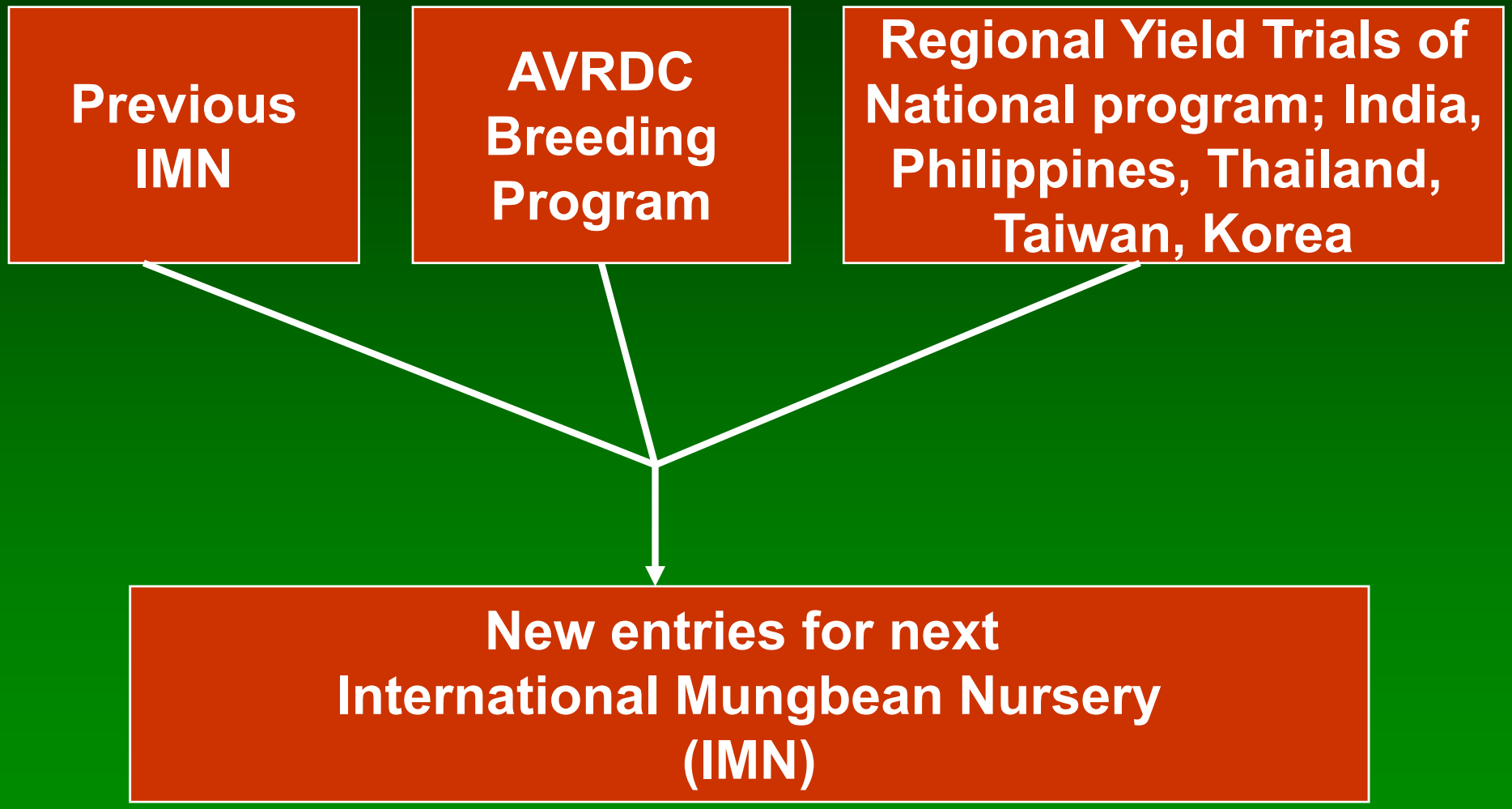
Gain from one generation of selction (12 experiments)

Pods/plant - 42.5 %

Seed yield - 34.4 %

Seed weight - 21.9 %

Seed/pod - 9.5 %


Previous IMN
AVRDC Breeding Program
Regional Yield Trials of National program; India, Philippines, Thailand, Taiwan, Korea
New entries for next International Mungbean Nursery (IMN)

International Mungbean Nursery (IMN)

Univ. of Missouri - 1971

Four IMNs

74 sites 2°S to 49°N Lat.

5th IMN - AVRDC

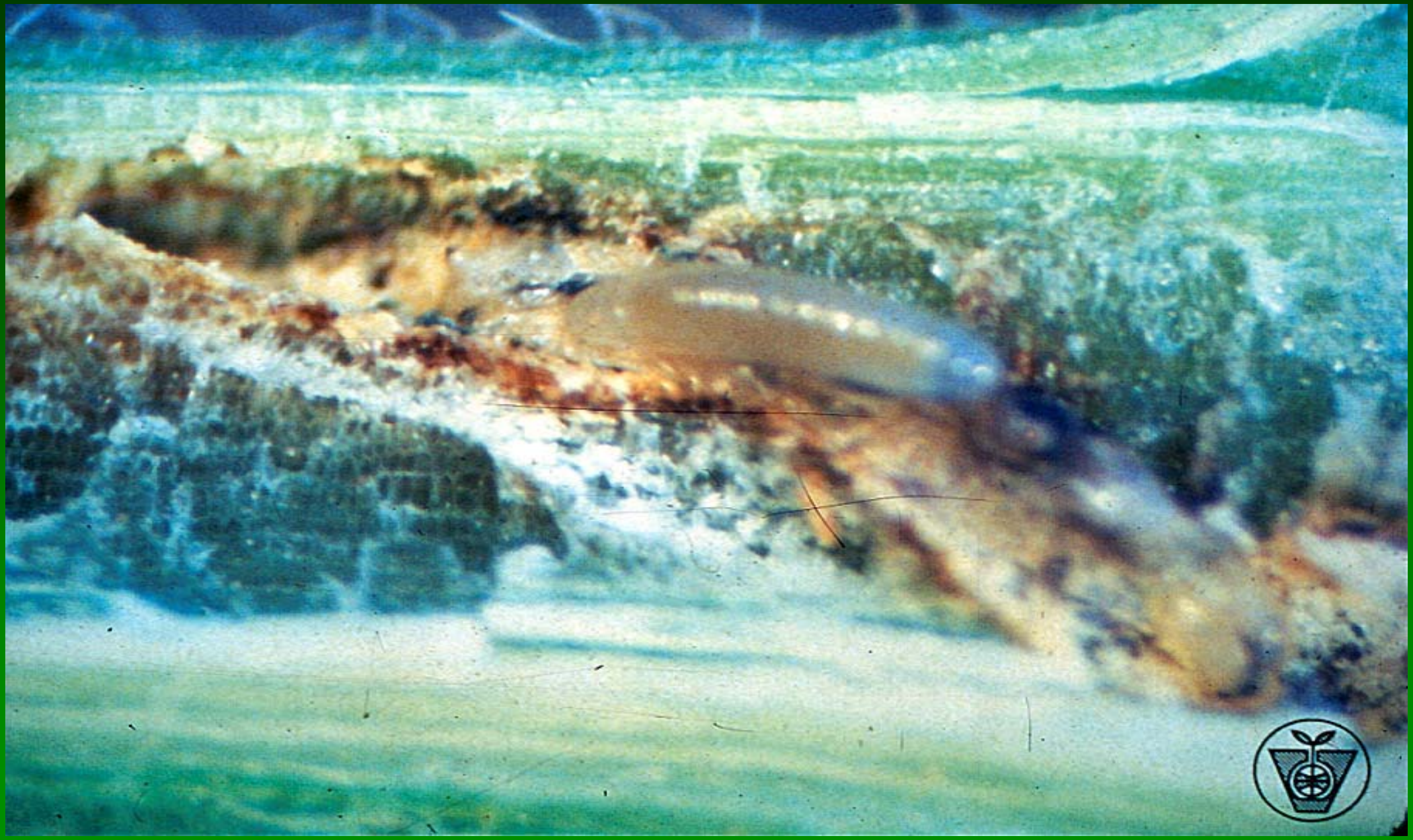
CONSTRAINTS TO PRODUCTION

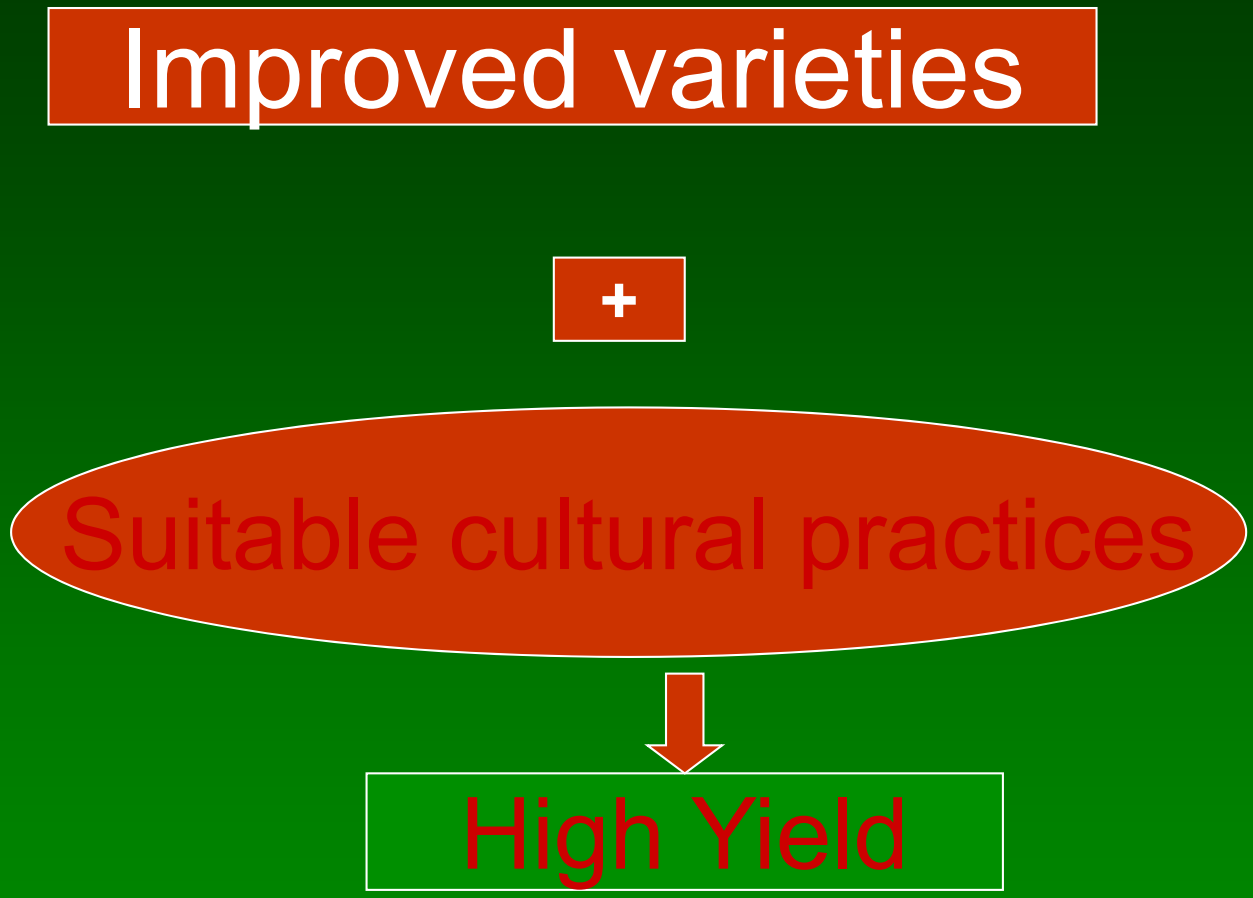

Powdery mildew (*Erysiphe polygoni DC)*


V 2273
RUM 21


Mungbean Yellow Mosaic Virus


Cercospora kikuchii (Cercospora leaf spot)




Improved varieties
+
Suitable cultural practices
High Yield

Do not plant mungbean after mungbean or cabbages in the same field.


稻豆新品種台南五號示範

Australia

Berken from	Oklahoma, USA (1975)
Celera	
King (Philippines)	AVRDC 1982
Shantung	
Emerald	CSIRO

Thailand

1960 -	Testing began
U. Thong	1976
DOA	
KU	KPS 1, 2
	Chainat 60
	P.S. 1

China

Collections in Hubei 1959, 1975

1988 onwards VC 1973A

AVRDC & China VC 2768A

USA

Oklahoma	Berken, Kiloga
	Oklahoma - 12
Texas	Texsprout
Missouri	IMN

Pakistan

Pulse Program	1980
Mutant	PAK 17 (1983) (Mung 28)
NM-92	NIAB/AVRDC

Vietnam

1960	Seed size
DX 91	AVRDC
DX 102a	AVRDC
DX 113	AVRDC

Mungbean

Bruchid resistance (*Callosobruchos chinensis*)

TC 1966	*V. radiata ssp. sublobata*
V 2709	*V. radiata* var. *radiata*
V 2802	"

V. radiata
x
V. radiata var. *sublobata*

Bruchid resistance

Mungbean Biotechnology

1. RFLP-marker assisted breeding for bruchid resistance and MYMV resistance.
2. Only two backcrosses needed with RFLP; without RFLP six backcrosses required.

Molecular genetic map

Saturated map > 200

Markers developed

Mungbean biotechnology

RFLP markers linked to the genes for:

PM

Bruchid resistance

Seed weight

Pod length

Days to maturity

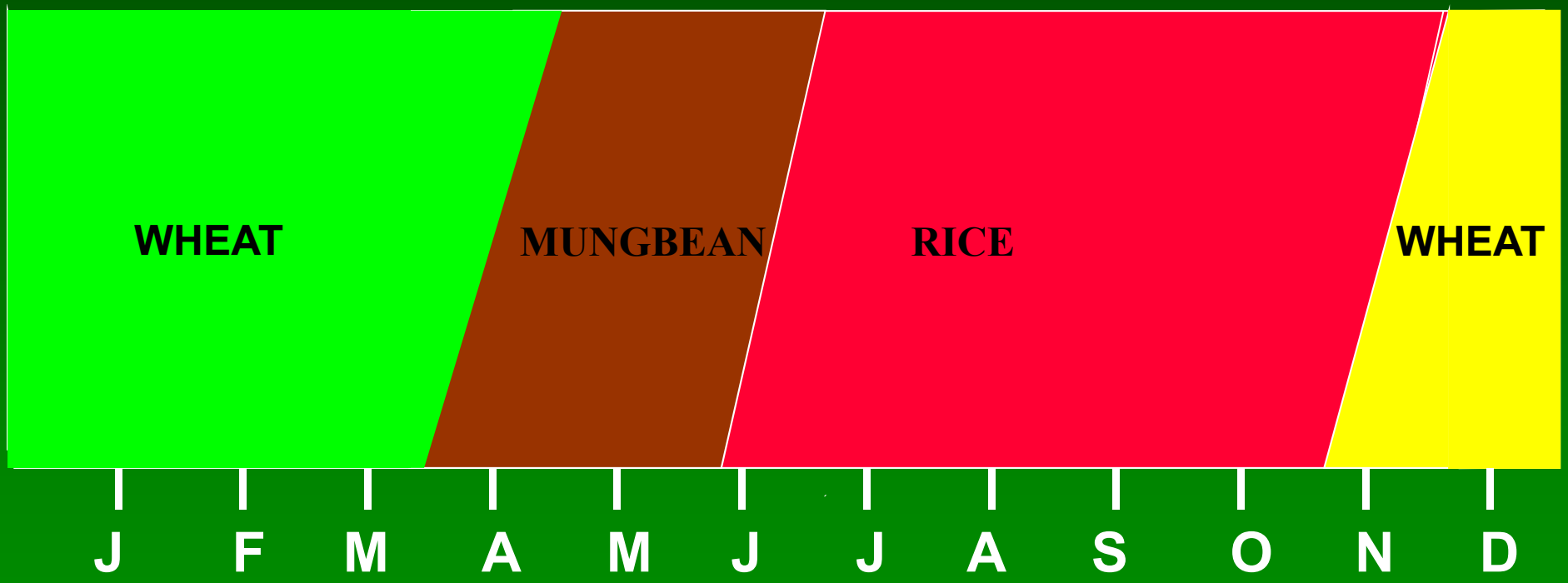
CLS

MYMV

Mungbean

- Important pulse crop in Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka
- Short maturity duration crop
- Protein
- Energy
- Iron
- Mungbean sprout

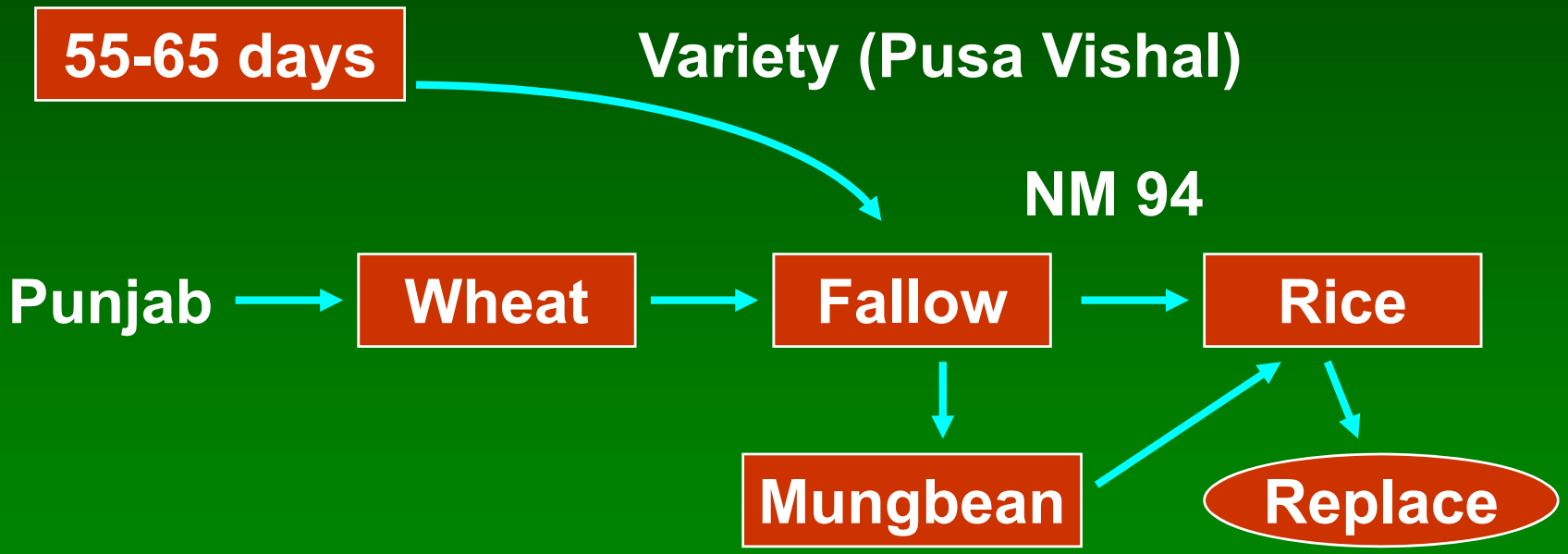
Mungbean matures in 60-80 days, which make it most suitable in cereal-based multiple cropping systems



India

Mungbean (India)

DFID Project at AVRDC



More than a million ha available

Mungbean Yellow Mosaic Virus

Yield loss = 100 %

Vector = Whitefly (*Bemisia tabaci*)

Chemical control = none

Managing the disease = Resistance

Mungbean

MYMV-resistant lines

NM 92
NM 94
VC 6144
VC 6146

Mungbean (MYMV)

Collaboration with NARS:

- Shuttle breeding with Pakistan
- Cross at AVRDC; F_1, F_2, F_3 at AVRDC
- F_4 selection for MYMV – Pakistan
- F_5 selection at AVRDC – CLS, PM
- F_6 selection for MYMV – Pakistan
- F_7 seed multiplication at AVRDC

Mungbean is poised to take off in South Asia

- Mungbean yellow mosaic virus
- Estimated yield loss in legumes : $300 million/year
- Estimated yield reduction: 10-100% (depend on time of infection)
- Cause: Whitefly transmitted virus
- Genetics: Susceptibility is dominant – may be two genes

Pakistan and India With AVRDC

Resistant Mungbeans

India	Pakistan
12-4	NM-28
4-3	NM-121-25
Black gram	NM-19-19
LGG 407	NM-20-21
LGG 450	NM-13-1
PDM 84-139	NM-51
PDM 84-143	NM-54
Pusa 105	
Pusa 101	

Location with High Yield Potential

Bangladesh -	Joydebpur
Bhutan -	Khangma
India -	Punjab
	Delhi (Uttar Pradesh)
Pakistan -	Faisalabad, Islamabad
Sri Lanka -	Maha Illuppallama

First Mungbean Symposium 1977

Second Mungbean Symposium 1987

Mungbean Yellow Mosaic Virus Symposium 1992

Mungbean Satellite Workshop 1994

Mungbean Subnetwork Workshop 1997

Non-synchronous maturity

VC 1628A sel

Components of Mungbean Network

- Multilocation evaluation of MYMV resistant varieties
- Socio-economic survey
- Monitoring virus strains
- Improving nutrition of children and women

International Consultation Workshop on Mungbean

Proceedings of the Mungbean Workshop

7-11 September 1997
Indian Agricultural Research Institute
New Delhi, India

Sponsored by
Overseas Development Administration, UK
United States Agency for International Development, USA

Organized by
Asian Vegetable Research and Development Center (AVRDC)
Indian Council of Agricultural Research (ICAR)
Indian Agricultural Research Institute (IARI)

Asian Vegetable Research and Development Center

Short Course on Multi-location Testing of Mungbean

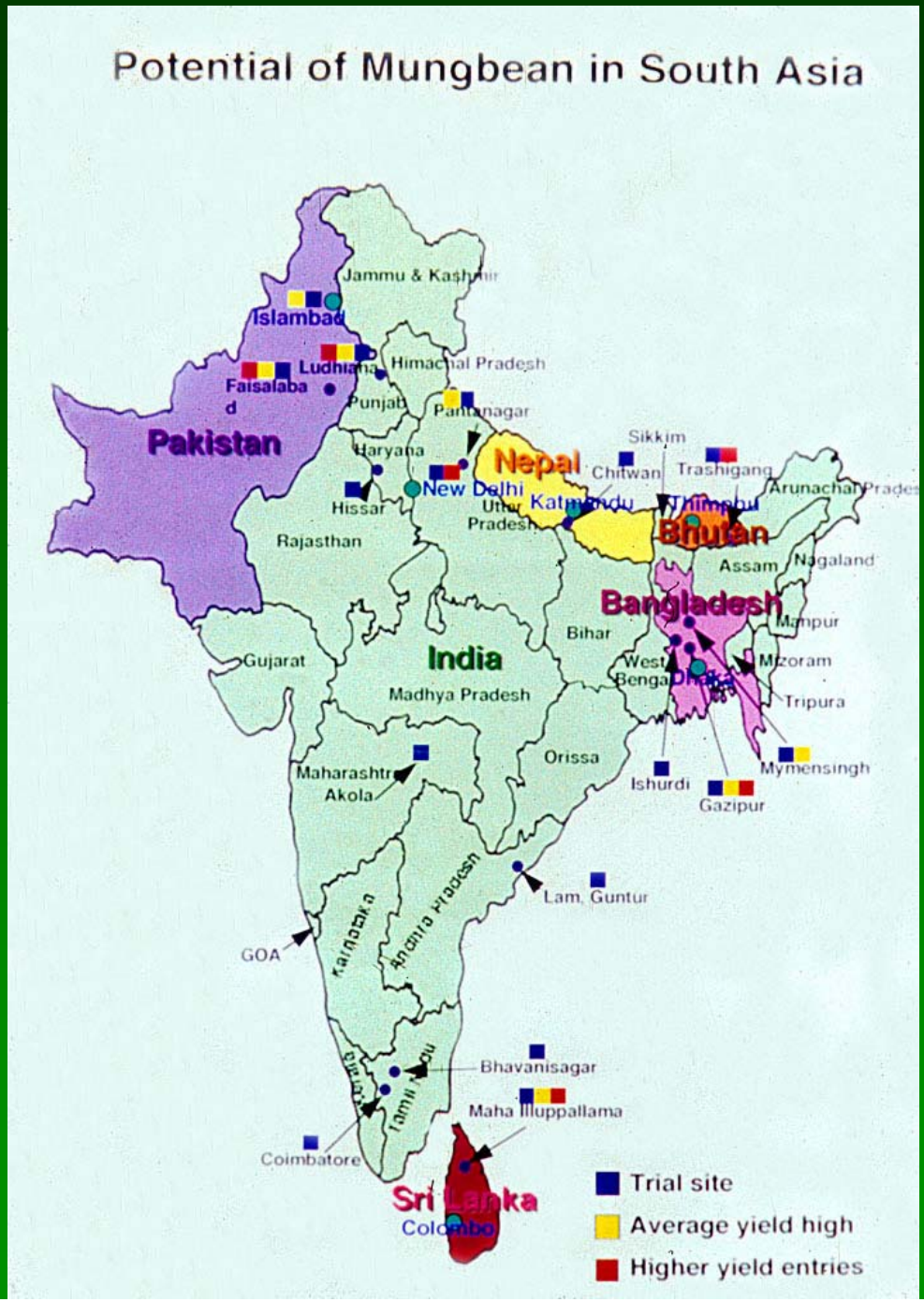
Location:	ARC/AVRDC, Thailand
Dates:	23-30 March 1998
No. of participants:	16
No. of countries:	6 (SAVERNET)

Multilocation Evaluation

No. of varieties: 32

No. of seasons: 2

No. of locations: 16


Potential of Mungbean in South Asia
Jammu & Kashmir
Islamabad
Ludhiana
Himachal Pradesh
Faisalaba
d
Punjab
Pantnagar
Pakistan
Haryana
Nepal
Sikkim
Chitwan
Trashigang
Arunachal Prades
New Delhi
Hissar
Uttar
Pradesh
Katmandu
Thimphu
Bhutan
Rajasthan
Assam
Nagaland
Bangladesh
Manipur
Bihar
Gujarat
India
West
Benga
Dhaka
Mizoram
Madhya Pradesh
Tripura
Orissa
Maharashtra
Akola
Ishurdi
Mymensingh
Gazipur
Lam, Guntur
GOA
Karnataka
Andhra Pradesh
Bhavanisagar
Tamil Nadu
Maha Illuppallama
Coimbatore
Sri Lanka
Colombo
Trial site
Average yield high
Higher yield entries

Northwest Zone of India

Potential Area:	10 million ha
Current cropping system:	Wheat-Rice
Between 2 cereals fallow period:	April to June (About 55-65 days)
Replace rice: (Water table)	From July

MYMV and yield of selected IMN-II entries at IARI, Delhi, India (1997 Kharif season)

Entry	Yield (kg/ha)	DM	MYMV	1000-seed wt. (g)
VC 6368 (46-13-2)	2,163	64	2.6	54
VC 6371-94	2,026	68	7.0	50
VC 6368 (46-3)	1,954	70	8.0	49
VC 6371 (207A)	1,796	72	8.0	48
VC 6386 (34-7)	1,735	68	7.3	53
Pusa 105 (check)	843	76	7.6	29

Promising Varieties

1. India

Variety	Yield (kg/ha)	DM	1000-seed wt. (g)
NM 94	2,051	56	60
NM 92	1,400	58	58
VC 6173-B-10	1,600	64	76
SML-32 (Improved check)	1,300	63	39

2. Bangladesh

Variety	Yield (kg/ha)	DM	1000-Seed wt. (g)
NM 94	1,700	70	62
VC 6153B-20G	1,700	66	60
NIMB-101	1,500	68	49
VC 6372 (45-8-1)	1,500	62	51
BIMA Moog-1 (ck)	941	83	30
BARI Mug-4 (ck)	1,228	70	30

3. Sri Lanka

Variety	Yield (kg/ha)	DM	1000-seed wt. (g)
KPS #2	1,700	63	55
VC 6173B-6	1,500	61	62
MI-5 (check)	1,200	65	61

4. Bhutan

Variety	Yield (kg/ha)	DM	1000-seed wt. (g)
KPS #2	2,100	90	55
BARI MUNG 2	2,100	90	53

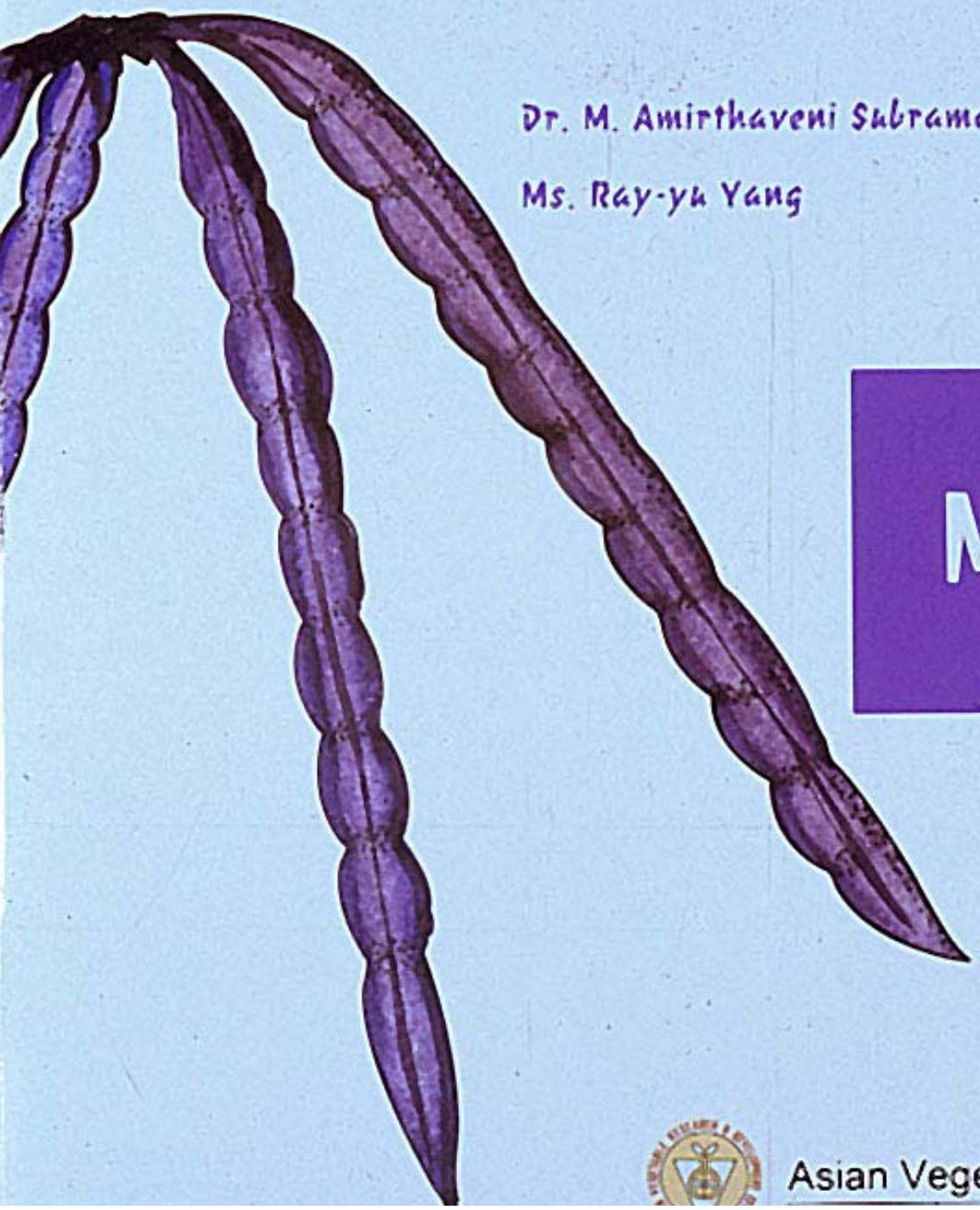
Yield Potential

1.5 to 2.0 t/ha in 55 to 65 days

300 kg/ha in 85 to 90 days (traditional)


ML-267
(PAU)
SOWING DATE-JULY2097


MULTILOCATION TRIAL OF MUNGBEAN VARIETIES
Location: Bangabandhu Agricultural University, Gazipur
Growing Season : Kharif II (September - November)
Varieties : 18
Plot Size : 4.0 m x 1.8 m
Planting Configuration : 0.30 m x 0.05 m
Design : RCBD ; Replications : 4
Planting Date : September 12, 1998.
South Asia Mungbean Network/AVRDC



Dr. M. Amirthaveni Subramanian &

Ms. Ray-yu Yang

High-iron Mungbean Recipes from South Asia

Asian Vegetable Research and Development Center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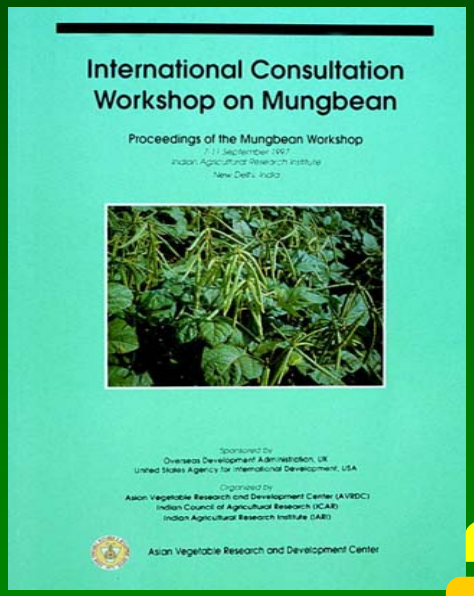
Participating NARS

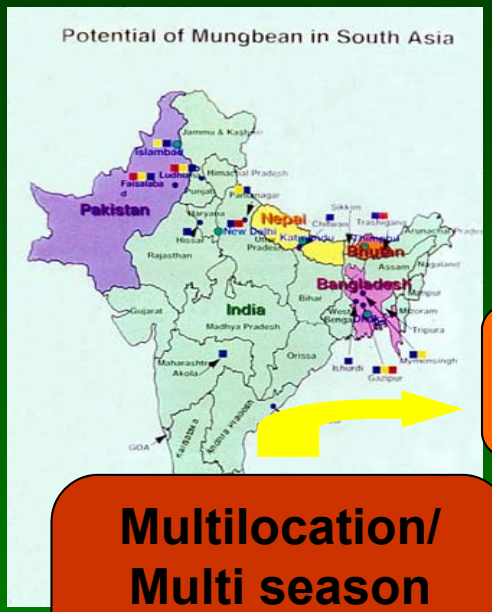
Bangladesh – BSMRAU, BARI

India – PAU, RWC CIMMYT

Nepal – CIMMYT, LI-BIRD, FORWARD

- Mungbean reaching on-farm production





Consultation/ Planning Workshop

1997

Training

1998

Multilocation/ Multi season Evaluation of Selections

1999-2000

Cultivar Release

2001

Cultivar Release
Seed Multiplication
On-farm Production
Agronomy Research

2002

1.5 m ha by 2005

SML 668

VC 1628A sel

Cultivars Released by NARS

Country	Cultivar Name	AVRDC Line	Institutes releasing
Bangladesh	BARIMUNG 5	NM-92	BARI
	BU Mug-1	VC 6372(45-8-1)	BSMRAU
	BU Mug-2	Vc 6372(30-65)	BSMRAU
India	Pusha Vishal	NM-92	IARI
	SML-668	NM-94	PAU
	Pant Mung-5	VC 6368	Pant Univ.
Bhutan	KPS-2	VC 2768A	Dept. of Agri.
	BARIMUNG-2	-	Dept. of Agri.

Desirable Traits of Improved Cultivars

Cultivar	Yield (t/ha)	DM	MYMV
Bangladesh			
BARIMUNG-5	1.5	50-55	Tolerant
BU MUG-1	1.4	50	Resistant
BU MUG-2	1.0	50	Resistant
India			
Pusa Vishal	1.7	65	Resistant/tolerant
SML-668	1.7	55-60	Resistant
Pant Mung 5	1.1	72	Resistant
Bhutan			
KPS-2	2.1	90	-
BARIMUNG-2	2.1	90	-
Nepal*			
KPS-1	0.9	65	

*Preliminary late planting.

Accomplishments in 2002

Summer season (After wheat)

No. of farmers	Cultivar
4,000	SML-668
930	Pusa Vishal

Kharif season (Instead of rice)

No. of farmers	Cultivar
5,300	SML-668
1,000	Pusa Vishal

Yield (t/ha) in different seasons and locations

Farmer		Experiment Station	
Mean	Range	Mean	Range
		Summer	
1.25	0.5-2.0	1.7	1.1-2.0
		Kharif	
1.07	0.5-2.0	1.7	1.3-2.12

Yield (t/ha) in different seasons and locations

Private Seed Co.		Seed Farm	
Mean	Range	Mean	Range
		Summer	
0.75	0.5-1.5	-	-
		Kharif	
0.85	0.62-1.25	0.75	0.6-1.2

Days to maturity in different seasons

Maturity	
Summer	Kharif
55-60 days	70-75 days

Mungbean Seed Production

Country	No. of		Amount of Seeds/tons Available as of 2002
	Agen-cies	Culti-vars	
Bangladesh	7	6	3,993.3
India	8	2	1,265
	15	8	5,758.3

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID#	Parentage	Year released	Country
~~Shantung~~	~~VC 1560*~~		~~1982~~	~~Australia~~
King	V 1388		1982	Australia
Satin	V 2018*		1987	Australia
Emerald	VC 3528A		1992	Australia
Shantung		EGMY-7 x VC 1560A	1988	Australia
Emerald	VC 3528A Sel.		1994	Australia
Delta	VC 1973A	VC 2768A (VC 1973A x VC 6601)	1998	Australia
BU Mug 1	VC 6372(45-8-1)	VC 6370-92 x [VC 2768A x (VC 1973A x V 6601)]	2000	Bangladesh
BU Mug 2	VC 6370(30-65)		2001	Bangladesh
BARI Mung-5	NM 92	VC 2768B x VC 1973A x VC 6601)	2001	Bangladesh
KPS 1	VC 1973A		2001	Bhutan
KPS 2	VC 2768A		2002	Bhutan
	BARI Mung-2		2002	Bhutan
Mmelegi	VC 1482E			Botswana
Kbalkoh 2	VC 2719A		1989	Cambodia
Kbalkoh 1	VC 2768A		1989	Cambodia

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID#	Year released	Country
Xu Yin No. 1	VC 1973A	1985	China
DX 102A	VC 2768A	1986	China
ER Lu No. 2	VC 2778A	1989	China
VC 1381	VC 1381	1991	China
VC 2917A	VC 2917A	1991	China
Nan Lu No. 1	V 1381		China
Yu Lu No. 2	Local x VC 1562A	1994	China
Ji Lu NO. 1	VC 2917A	1989	China
Ji Lu No. 2	Local x VC 2719A		China
Su Lu No. 1	VC 1973A	1989	China
Xujin #1	VC 1973A	1985	China
Zhong Lu #1	VC 1973A	1986	China
Yue Yin #2	VC 1973A	1986	China
Elu #2	VC 2778A	1989	China
V 1381	VC 1381	1989	China
Su Lu #1	VC 2768A	1989	China
V 2917	VC 2917A	1989	China
Yue Yin #1	VC 2768A		China
Xu Yin No. 1	VC 2768A	1989	China

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID#	Parentage released	Year	Country
ASVEG 78	VC 1089A	ML-3 x Ph.coll.1	1978	Costa Rica
INIAP 451	VC 1163	EG-MG-4 x ML-6	1985	Ecuador
Boliche 451	VC 1163A		1985	Ecuador
Station 46	VC 1000-45-B	EG-MG-16 x ML-3	1982	Fiji
Station 25	VC 1007-14-1	ML-11 x CES78-5-B	1984	Fiji**
Station 27	VC 1160-1-1-2-B	CES-55 x ML-3	1984	Fiji**
M 986	V 3554		1981	India
Pusa 101	V 3484*		1984, 1983	India
Pusa 105	VC 1137-2-B		1984, 1983	India
Pusa Vishal	NM 92	VC 2768B x VC 1973A x VC 6601)	2000	India
SML 668	NM 94	VC 6371-94	2000	India
Pant Mung 5	VC 6368(46-40-4)		2002	India

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID# released	Parentage	Year	Country	
Manyar	VC 1089-B29-3B -2-2-B	ML-3 x Ph.coll.1	1983	Indonesia	
Nuri	V 2773	ML-3	1983	Indonesia	
Walet	VC 1163A	EG-MG-4 x ML-6	1986	Indonesia	
Gelatik	VC 1160-22-2B -1-B	CES-55 x ML-3	1986	Indonesia	
Merpati	VC 2754A		1991	Indonesia	
Sriti	VC 3300A		1992	Indonesia	
Bangasa	V 3476		1980	Korea	
Seon Hwa Nogdu	VC 1973A	CESID-21 x EG-MG-16	1982	Korea	
Nam Pyang Nok Du #5	VC 1089B x		1992	Korea	Kyungle Jame
Nam Pyang Nok Du	VC 1073A x VC 2768B		1993	Korea	
Nam Pyang Nok Du	VC 1089B		1993	Korea	
Nampyeong-nokdu	Kyeonggijarae 5	V 2983/ VC 1089B	1993	Korea	
Nampyeong-nokdu	Kyeonggijarae 5	Bangasa/ VC1000C	1995	Korea	
	VC 1168B		1988	Laos	
	VC 1750A		1988	Laos	
	VC 1560D		1988	Laos	

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID#	Parentage	Year released	Country
			1983	Malaysia**
Kalyan	NM 94	VC 2768A // VC 1973A/V6601	2006	Nepal
Prateeksha	VC 6372(45-8-1)	VC6370-92///VC2768A //VC1973A/ V6601	2006	Nepal
NIAB MUNG 51	Gammary treated	VC 1973A / 6601 F1	1990	Pakistan
NIAB MUNG 54	Gammary treated	VC 1973A / 6601 F21	1990	Pakistan
NM 92	VC 2768B / VC 1073A		1992	Pakistan
NIAB MUNG 92	VC 2768B / NM 36	1996	Pakistan	
BPI Mg2	VC 1163D		1984	Philippines
BPI Mg4	VC 2764B, VC 2764A		1986	Philippines
BPI Mg7	VC 1973-3-B-3-B		1988, 1989	Philippines
BPI-Mg-9 Green)	VC 2768		1989	Philippines (Taiwan
PSB-Mg2	VC 3876		1996	Philippines
PSB-Mg3	VC 2764 (Y)		1996	Philippines
SIROC 1	VC 4080A		1989	Solomon Is.
Filsan	VC 1168B		1987	Somalia

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID# released	Parentage	Year	Country
Type 77 12-2-B	VC 1131-B-ML-3 x EG-MG-16	EG-MG-16 x	1982	Sri Lanka
MI-6	VC 6153B-20G		2004	Sri Lanka
Tainan Sel. No. 3	VC 1628A	PAG-ASA 1 x PHLV-18	1981	Taiwan
Tainan Sel. No. 5	VC 3890A		1989	Taiwan
Imara	V 1380		1983	Tanzania
KPS 1	VC 1973A	(CESID-21/ EG-MG-16	1986	Thailand
Chai Nat 60	VC 1178	MG50-10A (Y) x ML-6	1987	Thailand
PSU-1	VC 2768A		1988	Thailand
Chainat 36	VC 1628A		1991	Thailand
KPS II	VC 2778A	BPI glabrus 3// CES 44 / ML 3 /// CESID-21/ PHLV8)	1986	Thailand
Chainat 60	VC 1178	MG 50-10 ACY x ML-6	1987	Thailand
PSU 1	VC 2768A		1988	Thailand

AVRDC mungbean cultivars released around the world as of 2006.

Local name	AVRDC ID# released	Parentage	Year	Country
Tex-Sprout	VC 1973A	CESID-21 x EG-MG-16	1987	USA
DX 102A	VC 2768A	(Eg-MD-6D x ML03) x (CESID-21 x PHLV-18)	1985	Vietnam
DX 113	VC 2763A	(EG-MD-6D x ML-6) x Glab.-3 x VC1301)	1985	Vietnam (BPI
DX 91	VC 1560D		1986	Vietnam
V 87-13	VC 3178A		1989	Vietnam
V 87-141	VC 3061		1991	Vietnam
DX-135	VC 3528A		1991	Vietnam
044	VC 2768A	1985	1994,	Vietnam
VN 93-1	VC 2778B		1994	Vietnam
DX 103	VC 2770A			Vietnam
V 87-13	VC 3178A		1991	Vietnam
V 91-15	VC 3528A		1995	Vietnam
V 94-208	VX 4111A		1995	Vietnam

Heavy rains caused by typhoon or others during 2003~2005.

Date	Typhoon	Precipitation (mm)
2003/06/07		221
2003/08/04	Morakot (Small)	142
2004/07/02~03	Nindulle (Medium)	291
2004/08/24~26	Aere (M)	113
2004/09/11	Haima (S)	138
2004/12/03~04	Nanmadol (M)	116
2005/06/03		201
2005/06/12		170
2005/06/13~16		1038
2005/07/18~22	Haitang (Large)	631
2005/09/01	Talim (L)	268
2005/10/02	Longwang (L)	83

Socio-Economic Research

- Baseline survey
- Impact assessment

Approximately Estimated Impacts of AVRDC Mungbean on Asian Countries

Country	Mungbean acreage ('000 ha)			Major varieties	Estimated benefits/ year
	Total	AVRDC lines	%		
China	640	480	75	Zhong Lu # 1 & others	<<US20M
Myanmar	900	1000	90	NA	NA
Thailand	260	234	90	KPS1, KPS2, CN 36	<US$12M
Pakistan	200	180	90	NM-92	<US$20M
Others	4,148	100	2.4	Many	
Total	5,695	1,394	24		<<<US$52M

Exploit Mungbean with Value Added Products

Nutritional Value of Mungbean

- Protein 24%
- Vitamin A (mg) 94
- Ca (mg) 124
- Iron (mg) 7.3
- Zinc (mg) 3.0
- Folate (mg) 549
- Vitamin C (mg) 8*

- *Beansprouts
- -Calloway, et al., 1994, Gopalan, et al., 1989

Utilization of Mungbean with Value Added Products

RECIPES

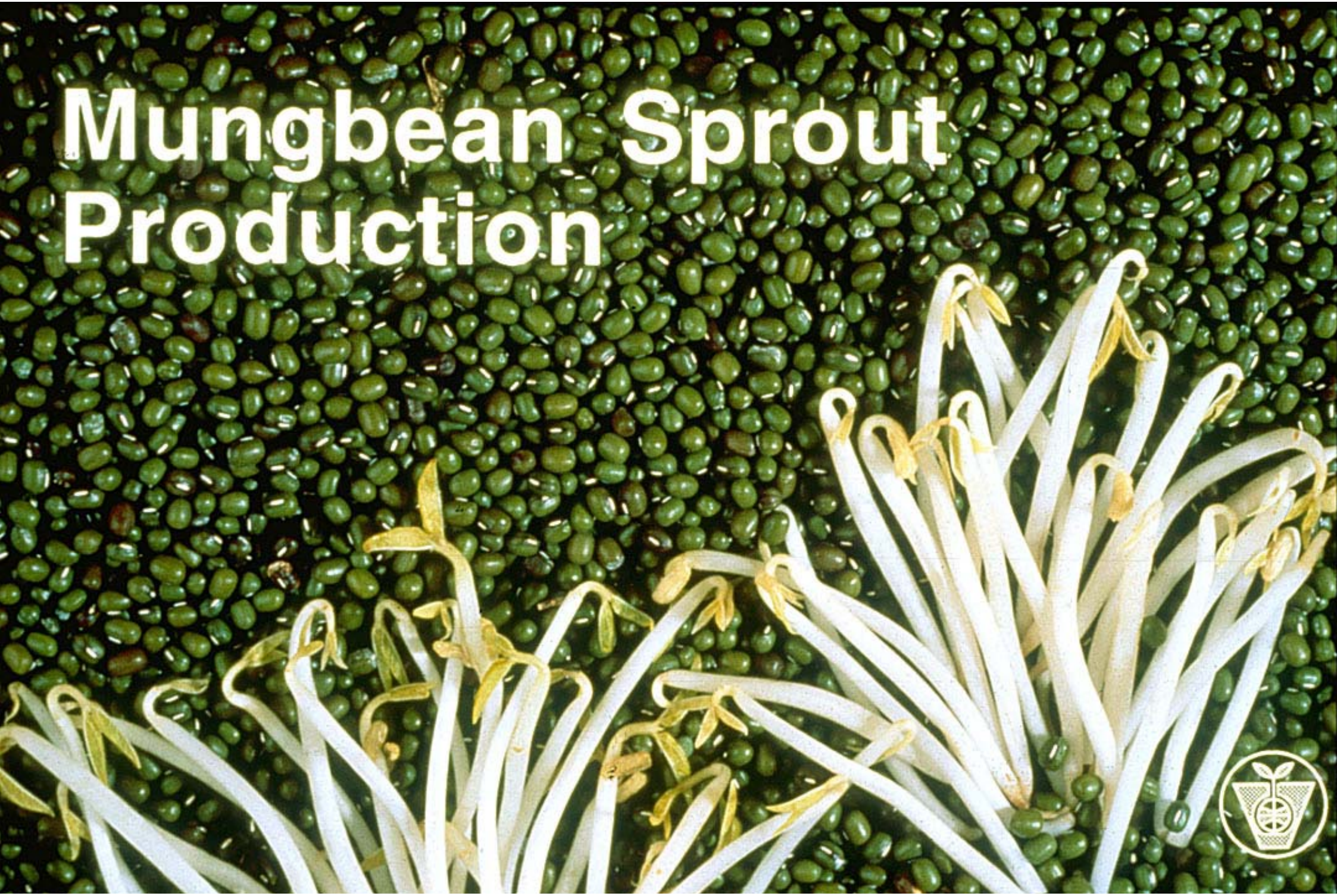
- Thirumaran and Seralathan, 1988
- Singh and Singh, 1988
- --Subramanian and Yang, 1998
- Bains, et al., 2003
- APO (2003)

RECIPE DEVELOPMENT


Packed in
polythene bags


MB sprouts

Mungbean Sprout Production



MB grain and its products

Fried MB


Black gram grain and toffee
including fried MB and MB noodle

Med Kanoon, sweet made of blackgram


Mungbean sweet


Mungbean sweet


Boiled mungbean with sugar


Sweet made of mungbean


ศูนย์วิจัยพืชไร่ชัยนาท
ศูนย์วิจัยพืชไร่ชัยนาท
สถาบันวิจัยพืชไร่
กรมวิชาการเกษตร

MB noodle

Protein and Fe Nutrition for the Poor through Mungbean Research

Uniform & short maturity duration (55-65 days) & 2 t/ha yield

Purpose

- Improve income
- Alleviate protein and iron malnutrition
- Crop diversification
- Soil sustainability
- Improve livelihood of rural poor

Mungbean Yellow Mosaic Virus Resistance

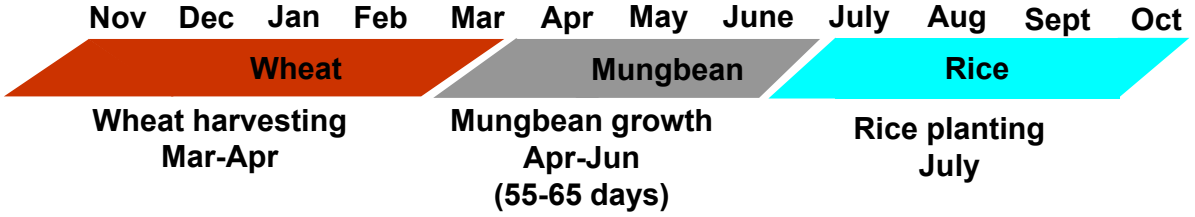
Accomplishments

- 74 mungbean cultivars from AVRDC released in 28 countries
- Mungbean cultivars in Southeast Asia are all from AVRDC
- Total economic surplus of mungbean

Thailand	Pakistan	China	Myanmar
US$15-18mio.	US$19.7 mio.	US$98 mio.	US$27 mio.

- Annual benefit due to enhanced nutrition in Pakistan US$3.5-4.2 million
- Additional income source for female laborers
- Additional income source for farmers through seed production

Introduction of Mungbean in Wheat-Rice system in South Asia



Target – 1.5 million ha by 2005