IPM packages for vegetable crops in India

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USAID
FROM THE AMERICAN PEOPLE

IPM-CRSP project (2005-2014)

Integrated Pest Management
IPM CRSP
Collaborative Research Support Program

IPM packages for major vegetables

Evaluation, promotion and dissemination through farmer-participatory methods

IPM developed and validated

Tomato, Okra, Eggplant, Onion (Shallot)

IPM development and validation in progress

Chili (hot) pepper, Cauliflower, Cabbage and Cucurbits

Major components in IPM approach

Use of bio-control agents/biopesticides
Monitoring through pheromone traps and yellow sticky traps
Use of trap crop and physical barrier crops
Cultural practices
Use of botanical pesticides and
Need-based application of eco-friendly pesticides

M A J O R P E S T S

Vegetables	Insects	Diseases	Nematode
Brinjal (Eggplant)	Shoot and fruit borer Leaf hopper, Whiteflies Epilachna beetle Ash weevil Red spider mite	Little leaf Wilt-nematode complex Root rot	RKN
Bhendi (Okra)	Fruit borers Red spider mite Whiteflies	Yellow vein mosaic virus Powdery mildew Root rot	RKN
Tomato	Fruit borers Leaf miner Thrips Whiteflies	Viruses- Leaf curl and Tospo Wilt Early blight	RKN
Onion (Shallot)	Thrips Cut worm Leaf miner	Bulb rot Purple blotch	RKN

MAJOR PESTS

Vegetables	Insects	Diseases	Nematodes
Hot pepper (Chili)	Thrips Yellow mite Whiteflies Aphids Fruit borers	Virus diseases Dieback &Fruit rot Damping off Powdery mildew	RKN
Cabbage	DBM Aphid Cutworm	Club root Leaf blight	
Cauliflower	DBM Aphid Cut worm	Leaf blight	
Cucurbits	Fruit fly Leaf miner Defoliators Insect vectors	Virus diseases Leaf spots	RKN

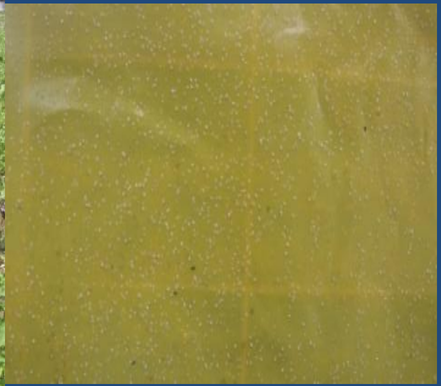
IPM components in vegetable crops

Components	Eggplant	Okra	Tomato	Onion
Seed treatment with *Trichoderma viride* (4g/kg)	X	X	X	X
Seed treatment with *Pseudomonas* @ 10 g/ kg of seed	X	X	X	X
Nursery + seedling dip treatment with *Pseudomonas* @ 10 g/ lit of water	X		X	
Soil application of Neemcake @250 kg/ha	X	X	X	X
Boarder crop (maize/ marigold/ castor/mustard)	X	X	X	X
Use of yellow sticky traps	X	X	X	X
Clipping of shoot borer infested terminals/Roguing virus infected plants	X	X	X	
Pheromone traps (*Leucinodes, Helicoverpa, Spodoptera*)	X	X	X	X
Parasitoid release (*Trichogramma, Acerophagus)*	X	X	X	
Application of Neem products (Azadirachtin based formulations/ NSKE 5%)	X	X	X	X
Need based Application of Pesticides	X	X	X	X

IPM components in vegetable crops

Components	Cabbage	Cauli-flower	Chili pepper	Cucurbits (Gourds)
Seed treatment with *Trichoderma viride* (4g/kg)	X	X	X	X
Seed treatment with *Pseudomonas* @ 10 g/ kg of seed	X	X	X	X
Nursery + seedling dip treatment with *Pseudomonas* @ 10 g/ lit of water	X	X	X	
Soil application of Neemcake @250 kg/ha	X	X	X	X
Boarder crop (Castor/mustard/marigold)	X	X	X	X
Use of yellow sticky traps	X	X	X	X
Clipping of shoot borer infested terminals/Roguing virus infected plants	X	X	X	X
Pheromone traps (*Leucinodes, Helicoverpa, Spodoptera*)	X	X	X	X
Parasitoid release (*Trichogramma, Acerophagus)*			X	
Application of Neem products (Azadirachtin based formulations/ NSKE 5%)	X	X	X	X
Need based Application of Pesticides	X	X	X	X

Eggplant IPM



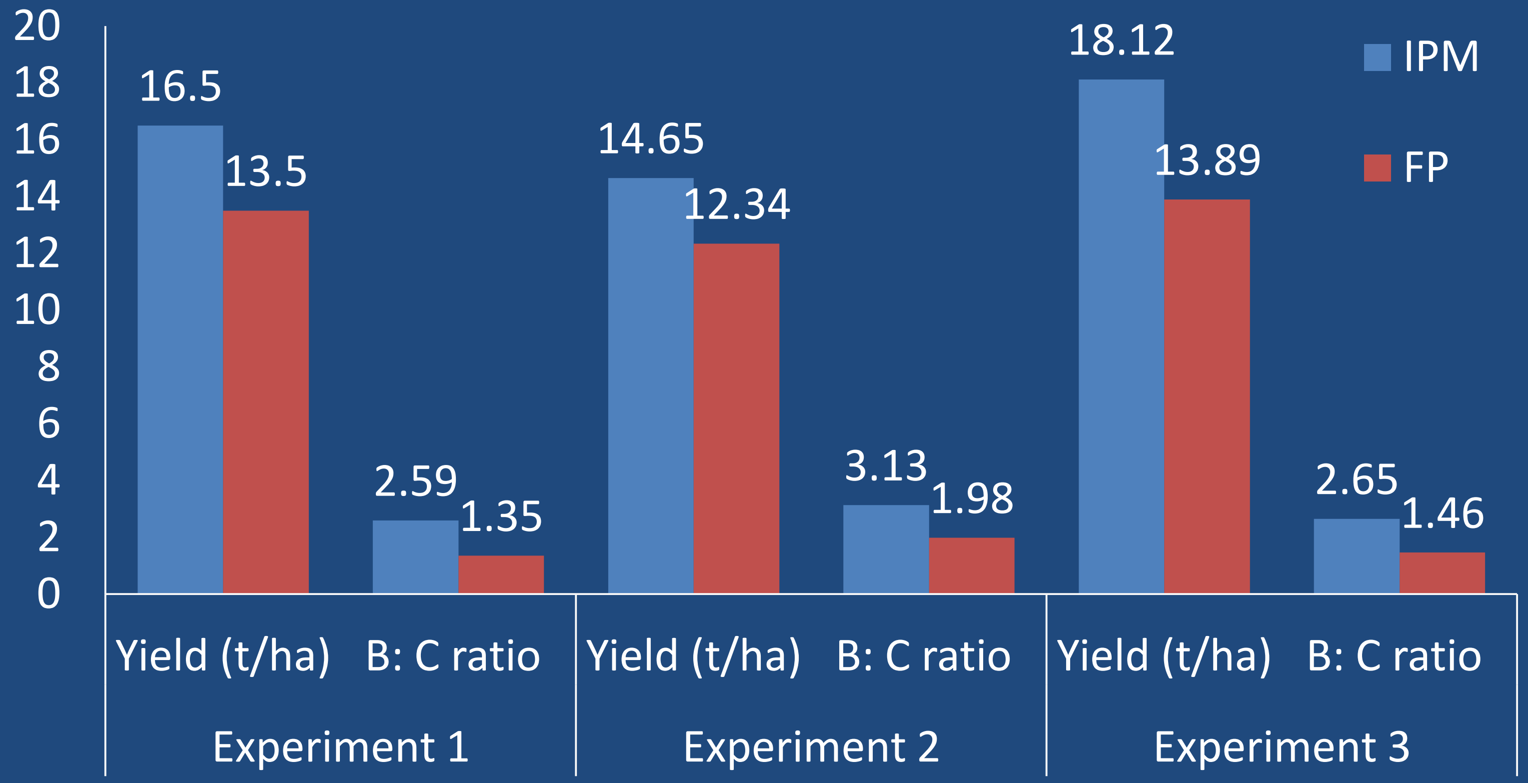
Impact of IPM on pests and Natural enemies in Eggplant

Parameters	IPM	FP
Aphid (% Plant damage)	**11.2**	**28.0**
Whitefly population (no./leaf)	**3.6**	**8.7**
Leafminer damage (% leaf damage)	**6.2**	**15.8**
Leafhopper population (no./leaf)	**2.3**	**5.6**
Fruit borer damage (%)	**12.6**	**31.8**
Epilachna beetle (% leaf damage)	**2.4**	**5.9**
Ash weevil (Leaf damage %)	**8.2**	**12.7**
Root rot (% infected plants)	**6.2**	**9.7**
M. incognita population (Population/250 ml soil)	**132**	**225**
Nematode gall index	**2.0**	**5.0**
Natural enemies (coccinellid beetles/ plant spiders, / plant syrphids /pl leafminer parasitism %)	**3.0** **2.0** **1.0** **18.0**	**1.0** **Stray** **Stray** **4.0**
Number of chemical sprays	**3**	**11**
Ecofriendly biopesticides sprays	**4**	**1**

Impact of IPM on pests and natural enemies in Eggplant

Details of observations	Expt. 1	Expt.2	Expt. 3
	% reduction over FP	% reduction over FP	% reduction over FP
Aphid population (%leaf damage)	45.62	35.63	53.67
Whitefly population (number per leaf)	52.84	59.26	58.64
Leafminer damage (% leaf damage)	35.62	45.62	48.26
Leafhopper population (number per leaf)	43.44	44.27	35.24
Fruit borer damage (% fruit damage)	63.44	74.27	75.24
Epilachna beetle (% leaf damage)	45.25	52.36	35.68
Ash weevil and root rot complex (% plants affected)	-	25.68	-
M. incognita population (Population/250 ml soil)	87.75	52.88	56.23
Nematode gall index	60.00	40.00	66.66
Percent increase in natural enemies (spiders, coccinellid beetle and leafminer and fruit borer parasitoids (*Trathala* sp)	26.38	38.26	29.65

IPM in Eggplant – Yield and Economics



The yield increase was 18.72 to 30.45 per cent in the IPM plots

The benefit received was also high in all three trials.

Field day in Eggplant

Okra IPM trials

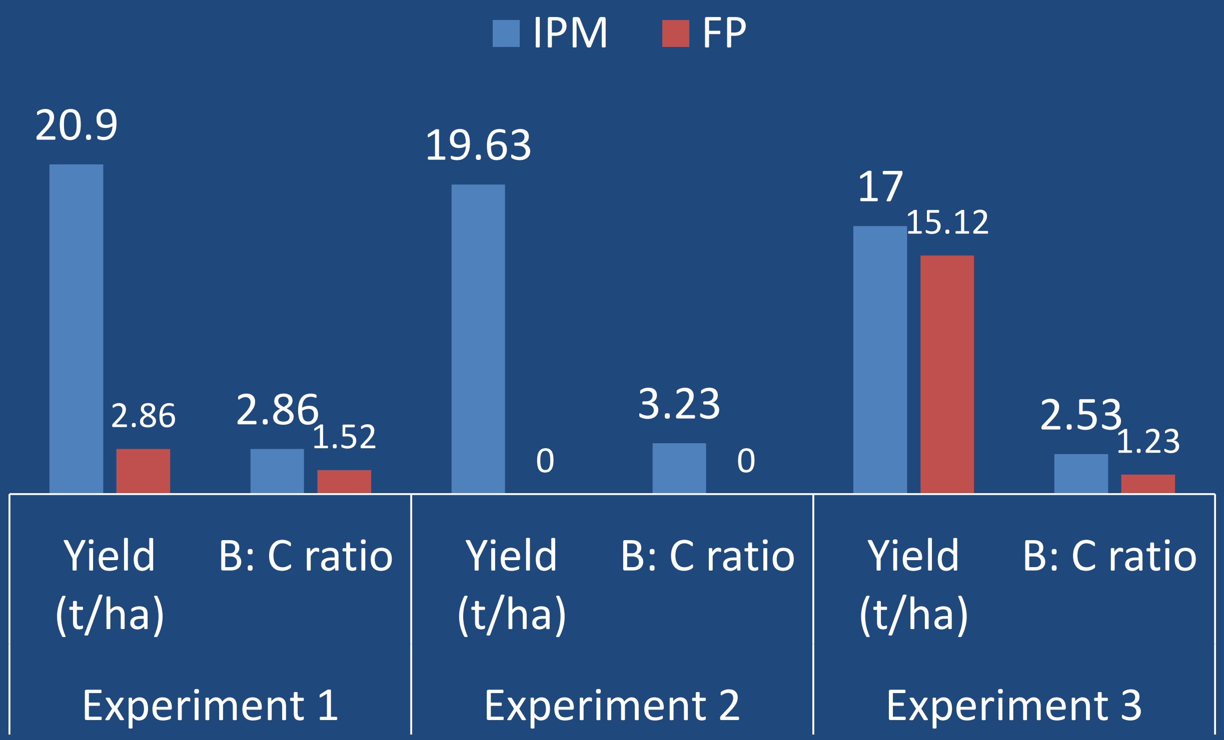
Impact of IPM on pests and Natural enemies in Okra

Parameter	IPM	FP
Aphid (% Plant damage)	4.1	6.0
Whitefly population (number per leaf)	9.6	18.5
Leafhopper population (number per leaf)	4.8	9.5
Serpentine leafminer damage (% leaf damage)	7.6	10.5
Fruit borer damage (%)	8.1	13.8
Yellow vein Mosaic (% infected plants)	2.8	7.1
Powdery mildew (PDI)	6.0	9.4
Root rot (% infected plants)	6.0	9.2
M. incognita population (Population/250 ml soil)	62.0	102.0
Nematode gall index	1.1	2.3
Natural enemies (coccinellid beetles,/ plant spiders, / plant syrphids /pl leafminer parasitism %	4.3 2.8 1.9 14.8	2.8 1.2 0.8 7.0
Number of chemical sprays	1	5
Ecofriendly biopesticides sprays	3	1

Impact of IPM on pests and natural enemies in Okra

Details of observations	Expt. 1	Expt.2	Expt. 3
	% reduction over FP	% reduction over FP	% reduction over FP
Aphid population (% leaf damage)	54.0	62.8	66.7
Whitefly population (number per leaf)	70.8	93.3	75.8
Leafhopper population (number per leaf)	64.2	-	65.8
Serpentine leafminer damage(% leaf damage)	45.3	52.6	59.2
Fruit borer damage (% damage in fruits)	62.8	-	65.8
Yellow vein Mosaic (% infested plants)	74.40	65.2	58.7
Powdery mildew (% leaf damage)	32.7	-	47.3
Root rot (% infested plants)	-	91.6	52.6
M. incognita population (Population/250 ml soil)	56.16	60.88	61.94
Nematode gall index	60.00	60.00	80.00
Percent increase in natural enemies (coccinellid beetles, spiders, syrphids leafminer parasitoids)	21.56	14.32	22.21

IPM in Okra – Yield and Economics



- **The yield increase was 12.43 to 45.54 per cent in the IPM plots above the farmers practice.**

- **The benefit received was also high in all the three trials**

Tomato IPM trials







Impact of IPM on pests and natural enemies in Tomato

Details of observations	Expt. 1	Expt. 2	Expt. 3	Expt. 4	Expt.5
	% reduction over FP	% reduction over FP	% reduction over FP	% reduction over FP	% reduction over FP
Thrips population (number per plant)	40.38	32.14	60.02	73.68	60.00
Leafminer damage (% leaf damage)	64.33	86.83	42.0	80.00	42.00
Whitefly population (number per leaf)	45.72	52.84	59.26	58.64	62.84
Fruit borer damage (% damage in fruits)	53.21	63.44	74.27	75.00	74.27
Leaf curl (% infested plants)	50.00	45.23	45.02	47.02	51.66
PBNV(% infested plants)	46.82	20.39	44.26	49.84	45.35
M. incognita population (Population/250 ml soil)	46.88	50.76	42.94	42.94	46.88
Nematode gall index	60.00	50.00	60.00	80.00	66.80
Percent increase in natural enemies (coccinellid beetles, spiders, leafminer parasitoids, *Chrysopa*)	23.62	28.48	31.05	18.68	24.53

IPM Field Trial on Tomato

IPM in Tomato – Yield and Economics

Details	Expt.1		Expt. 2		Expt. 3		Expt. 4		Expt. 5	
	IPM	FP	IPM	FP	IPM	FP	IPM	FP	IPM	FP
Yield (t/ha)	28.30 (+34.63)	18.50	29.80 (+40.56)	21.20	23.20 (+43.20)	16.20	22.90 (+60.13)	14.30	25.30 (+31.90)	17.23
B: C ratio	2.36:1	1.56:1	2.98:1	1.35:1	3.23:1	2.01:1	2.95:1	1.86:1	3.23:1	2.23:1

IPM: Integrated Pest management ; FP: Famers' practice

The yield increase was 31.60 to 60.13 per cent in the IPM plots relative to the farmers' practice.

Onion (Shallot) IPM

Impact of IPM on pests in Onion (Shallot)

Treatment	Thrips Population (No./plant)	Leaf miner damage (%)	Cut worm damage (%)	Basal rot (%)	Purple blotch (PDI)
Location I (Rabi 2009-10) Figures in parentheses are per cent increase over farmer's practice					
IPM	10.81 (27.2)	13.20 (44.1)	5.48 (40.0)	1.80 (67.9)	20.0 (56.1)
FP	14.85	23.61	9.13	5.60	45.6
Location II (Kharif 2010)					
IPM	3.36 (65.7)	-	0.97 (39.4)	7.25 (52.0)	-
FP	9.80	-	1.60	15.10	-
Location III (Kharif 2010)					
IPM	4.85 (52.5)	-	-	4.80 (61.0)	-
FP	10.22	-	-	12.30	-
Location IV (Rabi 2010-11)					
IPM	8.30 (48.0)	13.76 (30.5)	3.92 (42.8)	2.29 (54.6)	24.4 (47.8)
FP	15.95	19.80	6.85	5.04	46.7

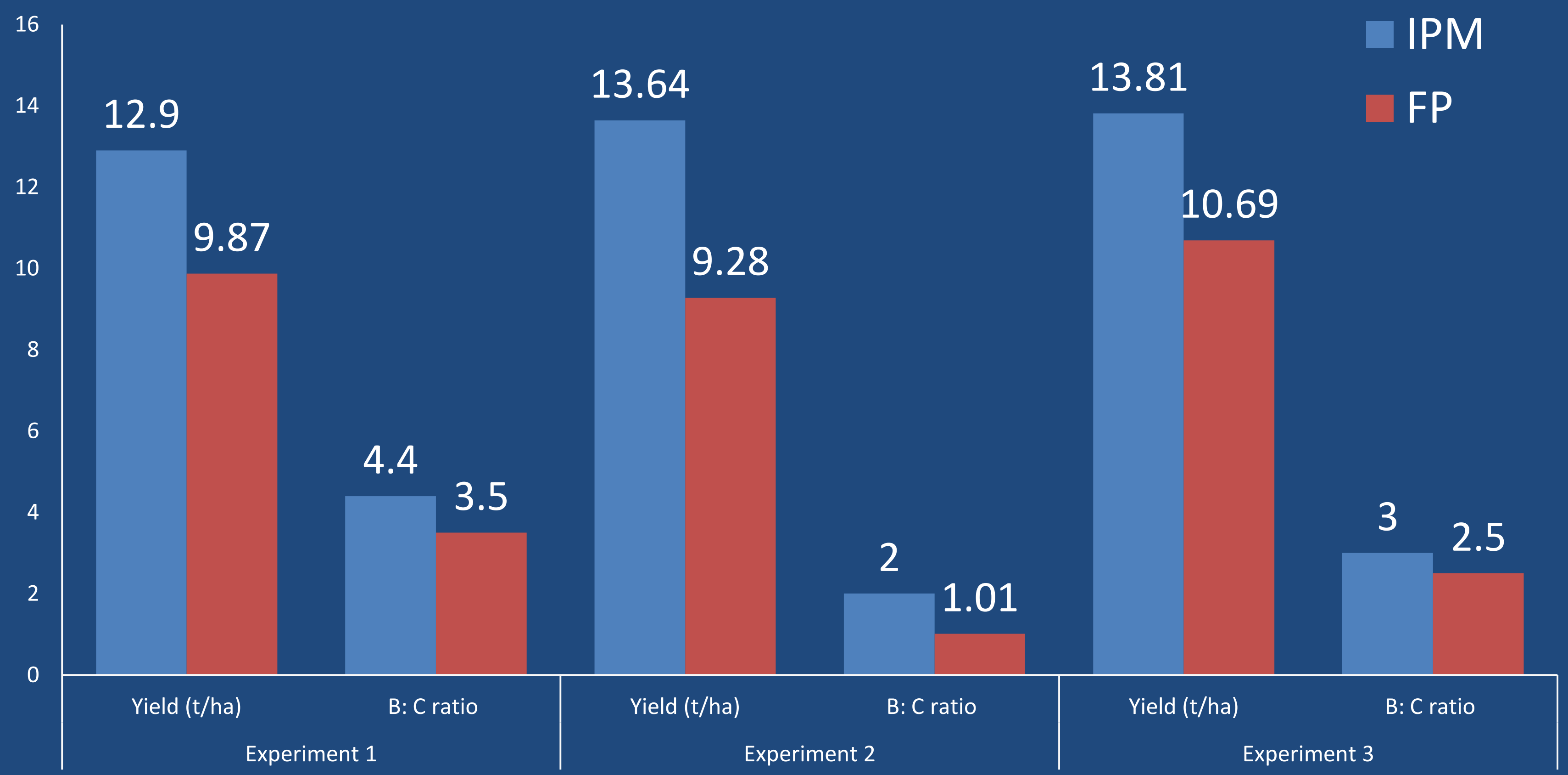
Impact of IPM on pests in Onion (Shallot)

Treatment	Thrips Population (No./plant)	Leaf miner damage (%)	Cut worm damage (%)	Basal rot (%)	Purple blotch (PDI)
Location V (Rabi 2010-11) Figures in parentheses are per cent increase over farmer's practice					
IPM	1.71 (60.5)	13.57 (28.1)	4.83 (34.3)	1.71 (60.5)	31.1 (46.2)
FP	4.33	18.88	7.35	4.33	57.8
Location VI (Rabi 2011-12)					
IPM	6.92 (51.8)	9.83 (39.7)	2.37 (61.5)	3.12 (51.7)	22.4 (60.1)
FP	14.35	16.29	6.15	6.46	56.1
Overall mean					
IPM	5.99 (48.3)	12.59 (35.9)	3.51 (43.6)	3.50 (57.0)	24.5 (52.5)
FP	11.58	19.65	6.22	8.14	51.6

IPM in Onion(Shallot) – Yield and Economics

Treatment	Bulb Yield (t/ha)	B:C ratio
Location I (Rabi 2009-10)		
IPM	15.62 (28.8)	1.84:1
FP	12.13	1.41:1
Location II (Kharif 2010)		
IPM	12.50 (20.2)	1.73:1
FP	10.40	1.48:1
Location III (Kharif 2010)		
IPM	13.60 (21.4)	1.96:1
FP	11.20	1.61:1
Location IV (Rabi 2010-11)		
IPM	14.58 (29.3)	6.36:1
FP	11.28	5.42:1

IPM in Onion – Yield and Economics



Technology dissemination

Cabbage IPM


TNAU – IPM CRSP
Integrated Pest Management in Cabbage
Components of IPM :

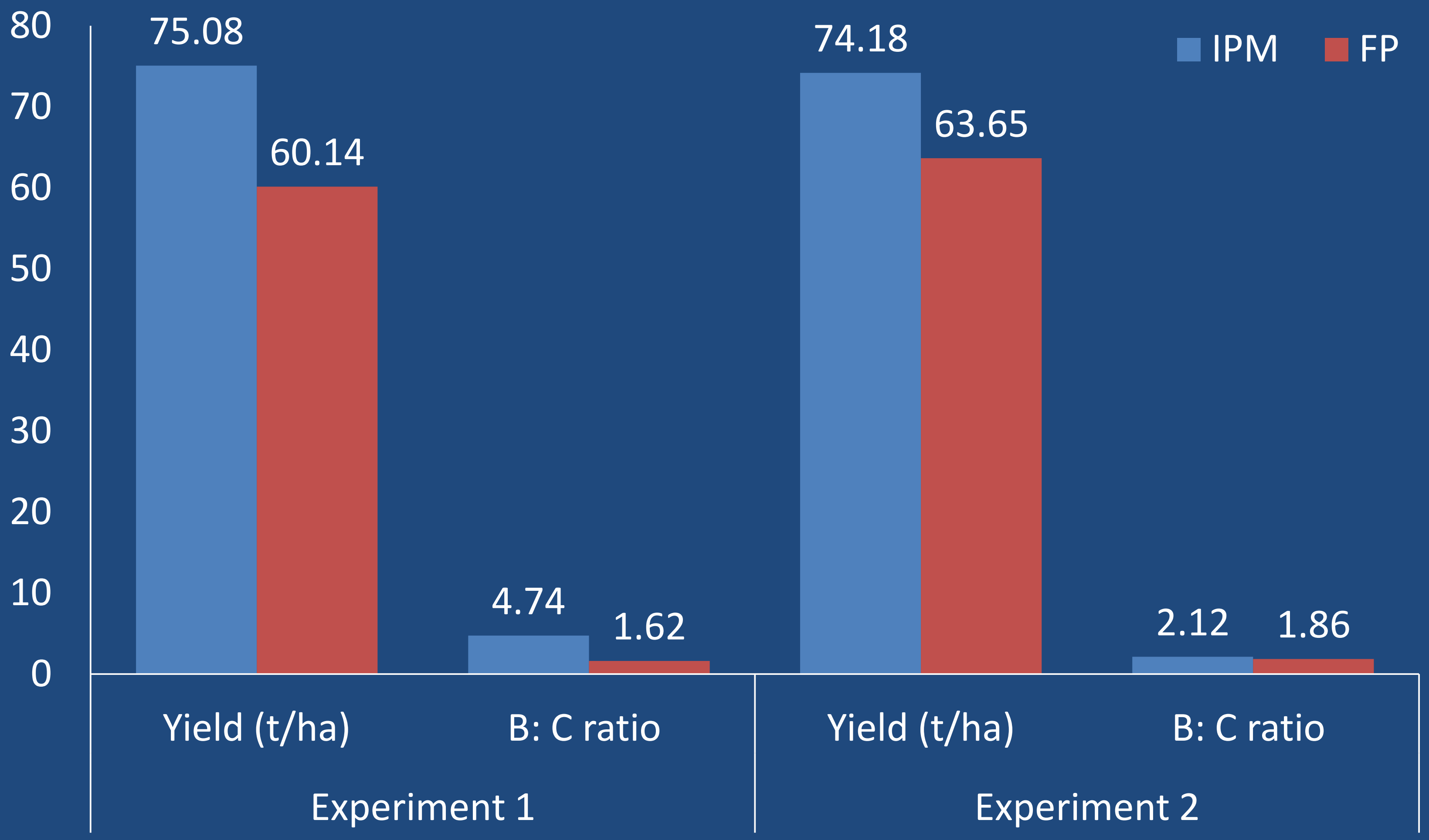
Impact of IPM on pests and Natural enemies in Cabbage

Parameter	IPM	FP
Cut worm damage %	4.0	11.0
DBM larval population / pl	8.0	18.0
DBM damage	4.0	16.0
Spodoptera leaf damage %	7.0	22.0
M. incognita population (Population/250 ml soil)	190	320
Nematode gall index	1	5
NE *Cotesia* Parasitism %	17.0	7.6
Number of chemical sprays	2	7
Ecofriendly biopesticides sprays	2	0

Impact of IPM on pests and natural enemies in Cabbage

	Expt. 1	Expt.2
Details of observations	% reduction over FP	% reduction over FP
Cutworm damage (% leaf damage)	45.2	35.6
Diamondback moth larval population (no./ leaf)	34.2	42.8
Diamondback moth and *Spodoptera* damage (% leaf/head damage)	41.1	46.6
M. incognita population (Population/250 ml soil)	41.0	34.3
Nematode gall index	75.0	66.7
Percent increase in natural enemies (coccinellid beetles, spiders, *Cotesia plutellae*)	32.6	28.7

IPM in Cabbage – Yield and Economics



Popularization of IPM- Cabbage- Field day

Cauliflower IPM

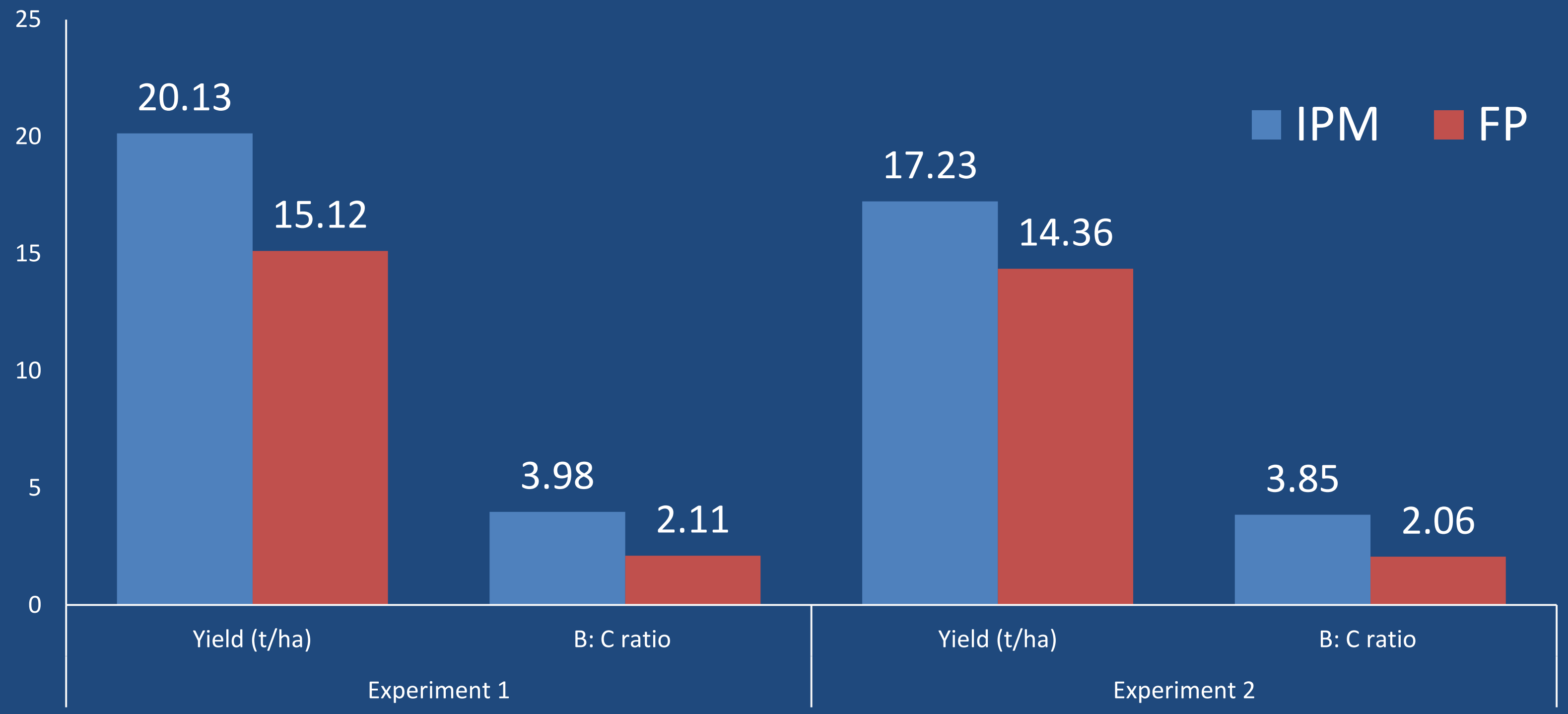
Impact of IPM in Cauliflower

Parameter	Expt.1		Expt. 2.	
	IPM	FP	IPM	FP
Cut worm damage %	3.6	8.2	1.6	3.4
DBM larval pop./ pl	2.4	5.6	5.4	12.2
DBM damage %	5.2	8.7	7.2	17.0
Spodoptera damage %	3.2	11.7	5.6	11.8
M. incognita population (Population/250 ml soil)	163	329	162	348
Nematode gall index	1	5	1	5
NE *Cotesia* Parasitism %	24.6	8.9	16.2	7.6
Number of chemical sprays	1	5	2	5
Ecofriendly biopesticides sprays	3	1	2	4

Impact of IPM on pests and natural enemies in Cauliflower in previous experiments

	Expt. 1	Expt.2
Details of observations	**% reduction over FP**	**% reduction over FP**
Cutworm (% leaf damage)	**52.84**	**45.64**
DBM population (no./ leaf)	**43.44**	**42.86**
DBM damage(% leaf/head damage)	**63.44**	**56.82**
***Spodoptera*(% leaf/head damage)**	**45.62**	**38.98**
***M. incognita* population (Population/250 ml soil)**	**46.91**	**34.21**
Nematode gall index	**82.68**	**60.00**
Percent increase in natural enemies (coccinellid beetles, spiders, *Cotesia plutellae*)	**26.82**	**29.87**

IPM in Cauliflower – Yield and Economics



The yield increase was 19.98 to 33.13 per cent increase in the IPM plots above the farmers' practice.

IPM in cucurbits

Fruit fly, leafminer, defoliators, insect vectors, Virus diseases, leaf spots, RKN

Impact of IPM in Ashgourd and Pumpkin

Parameter	Ashgourd		Pumpkin	
	IPM	FP	IPM	FP
Fruitfly (% affected fruits)	2.3	6.4	-	-
Cucumber beetle (% plant damage)	1.3	12.7	3.5	16.8
Whitefly (no./plant)	stray	stray	2.2	5.1
Powdery mildew (PDI)	1.9	4.7	2.7	4.2
M. incognita population (Population/250 ml soil)	148	320	174	320
Nematode gall index	1	5	2	4
CMV (% Infection)	6.8	13.3	4.6	9.4
Number of chemical sprays	-	3	1	4
Ecofriendly biopesticide sprays	2	-	2	-
Yield(t/ha)	17.70	14.62	19.30	15.10
B:C ratio	1.89:1	1.35:1	2.06:1	1.48:1

Impact of IPM in Bitter gourd and Snake gourd

Parameter	Bitter Gourd		Snake gourd	
	IPM	FP	IPM	FP
Leaf miner (% damage)	0.2	0.3	6.3	16.9
Leafhopper (no./plant)	3.6	12.3		
Whitefly(no./plant)	stray	stray	2.2	3.2
Fruitfly (% affected fruits)	6.4	20.5	10.6	36.8
Epilachna damage (% leaf damage)	6.5	23.4		
Semilooper (% leaf damage)	-	-	8.2	25.3
Powdery mildew (PDI)	3.7	4.8	-	-
M. incognita population (Population/250 ml soil)	152	390	142	389
Nematode gall index	2	5	1	5
CMV (% Infection)	13.5	29.1	8.8	13.4
Number of chemical sprays	1	7	2	8
Ecofriendly biopesticides sprays	2	0	2	0
Yield (t/ha)	39.60	33.00	15.23	12.65
B:C ratio	2.42:1	1.68:1	1.95:1	1.26:1


USAID
Virginia Tech
TNAU – IPM – CRSP
Integrated Pest Management in Snakegourd
Variety : Palur (SG)1
Date of Sowing : 06.06.2012
• Soil application of Neemcake @250kg/ha
• Soil application of *Pseudomonas fluorescens* @ 2.5kg/ha
• Soil application of *Trichoderma viride* @ 2.5kg/ha
• Keeping yellow sticky traps
• Setting of pheromone traps
• Application of botanical pesticides (NSKE 5%/Neem oil)
• Release of biocontrol agents (*Trichogramma*, *Chrysoperlla*)
• Need based application of insecticide/ Acaricide / Fungicide)
IPM-CRSP Scientists
TNAU, Coimbatore

Chili (hot) pepper IPM

Impact of IPM in Chili (hot) pepper

Parameter	IPM	FP
Mean thrips population (no./leaf)	2.92	4.24
Fruit borer damage (%)	2.68	3.35
Yellow mites (no./leaf)	4.60	6.23
Damping off (%)	1.3	9.7
Cercospora leaf spot (PDI)	26.4	34.0
Fruit rot (%)	4.4	7.9
Green chilli fruit yield (t/ha)	35.73	31.38
Number of chemical sprays	2	9
Ecofriendly biopesticides sprays	4	1
C:B ratio	1:2.38	1:2.02

Classical biological control of papaya mealybug

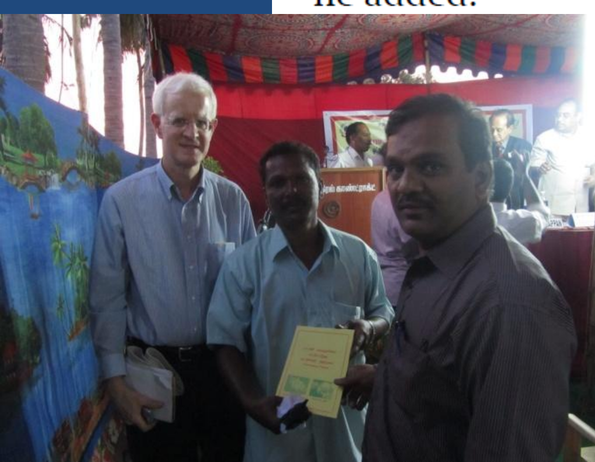
Once the USDA parasitoids arrived in India, Tamil Nadu Agricultural University (TNAU) under the guidance of NBAII took the lead in further breeding efforts and trained scientists on management, release, and conservation of the parasitoids.

1mm

Saved 35M

"The Tamil Nadu Agricultural University bred the parasitoids in 57 different locations in the state at a total investment of $200, 000," said Dr P. Murugesa Boopathi, the Vice-Chancellor of the University. "With the release of the parasitoids, farmers in the state stopped using pesticides, saving $35 million." he added.

NBAII Celebrates Successful Biological Control of Papaya Mealybug in India- Oct 20,2012



William Hammink, Mission Director, USAID India sums up, "this partnership demonstrates the whole of government approach in international co-operation. The significant role played by USAID and USDA is the way forward for future collaborative efforts."

Technology dissemination

Technology dissemination

Challenges in vegetable IPM

- Technology gap- Diagnosis for nematodes and
- Diagnosis and management of Viruses

- Change of cultivar/hybrid season after season
- Availability of quality bio-inputs at door step (as like pesticides)
- Gap between knowledge and adoption
- Need for better extension service at field level
- Fluctuation in market price of the produce

- No single package is suitable for a region/ state/ country/ continent

- Packing technologies suited to individual village/farm

Sharing knowledge with other IPM-CRSP host countries

Sl . No.	Name of the training / Workshop	Duration	Participants
1	International Plant Virus Disease Network Workshop	12th to 16th July 2010	Total:25 Female:11
2	Production of Biocontrol agents (*Pseudomonas* and *Trichoderma*)	18th to 21st July 2011	Total: 11 Female:5
3	Research and Management of Insect-transmitted virus diseases in vegetables in the tropics and subtropics	10th to 13th July 2012	Total:34 Female:13

Other Institutes working on vegetable IPM in India

INDIAN INSTITUTE OF HORTICULTURAL RESEARCH
A premier Institute of Indian Council of Agricultural Research
भारतीय बागवानी अनुसंधान संस्थान

Indian Institute of Vegetable Research
(Indian Council of Agricultural Research)
भारतीय सब्जी अनुसंधान संस्थान

SAUs- AICVIP

TERI, New Delhi & NGOs

Thanks to……

ENTOMOLOGY 2012
ESA 60TH ANNUAL MEETING
NOVEMBER 11-14, KNOXVILLE, TN

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