



Research Article

DEMONSTRATION OF INTEGRATED PEST MANAGEMENT PRACTICES IN BITTER GOURD (*Momordica charantia* L.) AND RIDGE GOURD (*Luffa acutangula* L.)

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Abstract: Cucurbits suffer yield loss due to insect pest and diseases and the farmers incur more than 25 - 30% of the cultivation expenses towards the plant protection in Dharmapuri district. Front line demonstrations (FLD) were conducted in bitter gourd and ridge gourd to demonstrate the integrated pest management components viz., seed treatment, application of neem cake, installation of sticky and fruitfly traps, periodical removal of infested fruits and need application of insecticides. The percent incidence of fruitfly in demonstration was 8.90 in bitter gourd and 15.37 in ridge gourd whereas in farmers practice the percent incidence was 23.35 and 32.12. The integrated management practices in bitter gourd recorded 26.4% yield increase during 2015 -16 and 17.17% yield increase in ridge gourd. The IPM module recorded benefit cost ratio of 3.40 in bitter gourd and 2.70 in ridge gourd and 2.09 and 2.2 in farmers practice. The lower yield, decreased returns and higher plant protection cost in farmers practice shows the non adoption of integrated pest management practices. The technology gap was 194q/ha for bitter gourd 106 q/ha in ridge gourd. The technology index for the present IPM demonstration for bitter gourd was 37.36 and for ridge gourd was 35.33. The lower technology index reveals the feasibility of demonstrated technology and sustained efforts required to disseminate among farmers.

Keywords: Bitter gourd, Ridge gourd, Fruitfly, Leafminer, Mosaic, Technology index

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Introduction

Cucurbits are one of the important vegetable crops cultivated throughout India either in permanent trailing system or in temporary structures. Cucumber (*Cucumis sativus* L.), bitter gourd (*Momordica charantia* L.), ridge gourd (*Luffa acutangula* (L.)), bottle gourd (*Lagenaria siceraria* (Molina) Standl.), snake gourd (*Trichosanthes cucurbitina* L.) and melons are the major cucurbits cultivated in Tamil Nadu. In Dharmapuri district bitter gourd, ridge gourd, snake gourd, bottle gourd, cucumber and melons are widely cultivated either in drip fertigation or regular irrigation method. The gourds and melons are cultivated in approximate area of 2500 hectare in Dharmapuri district both in *kharif* and *rabi* season. The farmers of this region usually cultivate gourds in 0.1 to 0.2 ha area throughout the year as this crop provides sustained income than the other vegetables. The farmers use permanent establishment such as stone pillars or concrete pillars to cultivate the gourds which reduces the chance of crop rotation with different crops for a brief period which is one of the management strategies to reduce the regularly occurring pest and diseases. The melon fruitfly *Batocera* spp., aphids *Aphis gossypii* Glover, pumpkin beetle *Aulacophora* spp. and leafminer *Liriomyza trifolii* are some of the major insect pests encountered by the farmers of this region along with mosaic and leafspot diseases. Among these fruitflies are the major insect pests detrimental to the cucurbits. The female flies lay eggs in fruits and the emerging larvae feed on the pulp of the fruit. Through the egg laying holes other pathogens enter the fruits leads to rotting and premature falling of fruits. About 50% of the cucurbits are partially or completely damaged by fruitflies in India [1]. Manoj et al., (2017) [2] in their study on preference of melon fruit fly *Bactrocera cucurbitae* (Coquillett) in cucurbits found that the preference was in the order of snake gourd > bitter gourd > ridge gourd > bottle gourd. The pumpkin beetle grubs and adults feed on all parts of the plants and as the potential to cause loss up to 35-75% at seedling stage and 30-40% at the field condition.

The leafminer mine the mesophyll of leaf and feed on the sap. In the early stage of the crop this pest causes serious damage and leads to drying if unattended.

The insecticide application is the primary management strategy followed by the farmers to manage cucurbit pests. Some of the cucurbit growers aware about the use of methyl eugenol traps to mass trap the fruitfly adults. The regular and indiscriminate use of insecticide use leads to problems such as residue in the produce, resistance in the target pests, resurgence in the non target pests, imbalance in the pest defender ratio and hazards to human and animal health [3]. The use of chemical pesticides to control pest was not only burden to the environment and also increase the cost of cultivation [4].

These problems warrants search for pest management methods which reduce the insecticide usage without any compromise in yield and quality [5]. The increasing awareness about unwarranted effects of insecticides among the consumer and to maintain export quality in the produce the farmers has to adopt the management practice which reduce the insecticide. The agro ecological techniques such as sanitation using augmentation, trap plants, adulticide baits and creation of habitats for predatory arthropods reduced the insecticide use with substantial cost saving, decrease in yield loss and lower phytosanitary workload in cucurbits [6].

In Dharmapuri district the farmers usually spent more than 25% of cost of cultivation towards the plant protection. Though some of the farmers have knowledge about use of traps for fruitfly management they also install one or two traps per acre than the recommended 5/acre for monitoring fruitfly incidence. The knowledge on use of baited traps for mass trapping, yellow sticky traps for sucking pests and soil application of biocontrol agents for disease management are less among the cucurbit growers of this region. Front line demonstration (FLD) is one of the effective tools to disseminate the technology among the target farmers. The integrated pest management module to manage cucurbit pest was demonstrated

Table-1 Incidence of insect pests and diseases in front line demonstrations

Year of demonstration	Crop	Percentage incidence of pest and diseases *							
		Fruitfly		Leafminer		Mosaic		Leafspot	
		FLD	FP	FLD	FP	FLD	FP	FLD	FP
2015-16	Bitter gourd	8.90	23.35	11.85	25.24	3.33	8.78	15.95	24.78
2016-17	Ridge gourd	15.70	32.50	18.00	32.50	11.60	17.60	10.35	13.90
2017-18	Ridge gourd	15.05	31.55	17.70	29.30	16.55	23.85	10.20	15.00

Table-2 Yield and gap analysis of front line demonstration in gourds farmers' field

Year	Crop	Yield (q/ha)		% Increase in yield	Technology Gap (q/ha)	Extension Gap (q/ha)	Technology index
		FLD	FP				
2015-16	Bitter gourd	326	258	26.40	194	68	37.36
2016-17	Ridge gourd	167	142	17.60	133	25	44.33
2017-18	Ridge gourd	221	189	16.93	79	32	26.33

Table-3 Economics of front line demonstrations in gourds at farmers' field

Year	Crop	Economics of demonstration plots (Rs/ha)				Economics of farmers practice (Rs/ha)			
		Gross cost	Gross return	Net return	BCR	Gross cost	Gross return	Net return	BCR
2015-16	Bitter gourd	1,15,000	3,91,200	2,76,200	3.40	1,34,400	2,81,760	1,47,360	2.09
2016-17	Ridge gourd	45,000	1,16,900	71,900	2.6	45,000	99,400	54,400	2.20
2017-18	Ridge gourd	49,095	1,32,600	83,505	2.70	51,250	1,13,400	62,150	2.21

Table-4 Plant protection cost associated with FLD & farmers practice

Particulars	FLD (Rs/ha)	FP (Rs/ha)
Seed treatment with Thiamethoxam 30FS @ 5g/kg and with biocontrol agents	500	500
Fruitfly trap @ 12/ha @ Rs.150/trap & 3 replacement lures @ Rs.50/lure	3,600	-
Fruitfly trap @ 5/ha @ Rs.150/trap & 3 replacement lures @ Rs.50/lure	-	1,500
Yellow sticky traps @ 12/ha @ Rs.45/trap (polyvinyl sheet) (one time replacement)	1,080	-
Soil application of <i>Pseudomonas fluorescens</i> @ 5kg/ha + <i>Trichoderma viride</i> @ 5kg/ha along with neem cake @ 250kg/ha	8250	-
Need based insecticide application (up to maximum three sprays @ Rs.1500/ha/spraying (early stage) and Rs.2000/ha/spraying (later stage) for insecticide & Rs.40/tank towards application cost (Minimum 25 tank in early stage & 50 tank later stage)	10,500	-
Insecticide application (up to maximum three sprays @ Rs.1500/ha/spraying (early stage) and Rs.2000/ha/spraying (later stage) for insecticide & Rs.40/tank towards application cost (Minimum 25 tank in early stage & 50 tank later stage)	-	29,000
Total	23,930	31,000

through front line demonstration in bitter gourd and ridge gourd to increase the awareness about the available alternate pest management methods, reduce the expenditure incurred towards pest management, decrease the loss due to pest and disease and increase the yield.

Material and Methods

Front line demonstrations were conducted in the cluster villages of Palacode, Karimangalam, Pennagaram, Nallampalli and Pappireddipatti blocks of Dharmapuri district during 2015-16, 2016-17 and 2018-19. During 2015-16 the FLD was conducted in bitter gourd (10 farmers field) and during 2016-17 and 2018-19 in ridge gourd (20 farmers field). The major crop production, protection, marketing and other issues were collected through Participatory Rural Appraisal (PRA) in the cluster villages. The knowledge level about the use of different integrated pest management components in cucurbit was assessed before initiating the FLDs which indicated that the farmers have little knowledge about use of fruitfly traps but unaware about use of sticky traps for sucking pest management, seed treatment with insecticide and biocontrol agents for early protection and use of green chemistry molecules for the pest management. The following integrated pest management module was demonstrated and compared with the farmers practice

1. Summer ploughing to expose the fruitfly pupae in the soil
2. Seed treatment with Thiamethoxam 30FS @5g/kg and biocontrol agents
3. Soil application of neem cake @ 250 kg/ha before last ploughing along with *Trichoderma viride* and *Pseudomonas fluorescens* each @ 2.5 kg/ha
4. Installation of yellow sticky traps @ 12/ha
5. Installation of cue lure fruit fly traps @ 12/ha
6. Application of neem soap @10g/lit to manage leafminer population at early stage
7. Collection and removal of infested fruits at regular intervals and at each harvest
8. Spraying of Chlorantraniliprole 18.50% SC @ 0.3ml/lit or Spinosad 45 SC @ 0.5 ml/lit to manage fruit fly and other caterpillar pest menace

The incidence of economically important insect pests and diseases viz., fruitfly, leafminer, mosaic and leaf spot were recorded at fortnight intervals in randomly selected 50 plants and expressed in terms of percentage. The fruitfly infested

gourds also weighed at each harvest to calculate the percentage of unmarketable gourds due to fruitfly incidence. The yield data at each harvest was recorded in the demonstration and farmers practice and cumulative yield was worked out. The cost of cultivation was calculated based on the average market price prevailed during the respective years.

The data were subjected for analysis using formula described below

$$\text{Percent yield increase} = \left[\frac{(\text{Yield in FLD (q/ha)} - \text{Yield in FP (q/ha)})}{\text{Yield in FP (q/ha)}} \right] \times 100$$

The benefit cost ratio was calculated using the following formula

$$\text{B:C ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}}$$

From the collected data technology gap, extension gap and technology index were a workout [7] as follows:

$$\text{Technology gap} = \text{Potential yield} - \text{Demonstrated yield}$$

$$\text{Extension gap} = \text{Demonstrated yield} - \text{Yield in farmers practice}$$

$$\text{Technology index} = \left[\frac{(\text{Potential yield} - \text{Demonstrated yield})}{\text{Potential yield}} \right] \times 100$$

Results and Discussion

The results of incidence of insect pest and diseases were presented in [Table-1] reveals that the IPM practices in bitter gourd during 2015 -16 and ridge gourd during 2016-17 & 2017-18 reduced the pest and disease incidence than the farmers practice. The percent incidence of fruitfly, leafminer, mosaic and leaf spot in bitter gourd was 8.90, 11.85, 3.33 and 15.95 respectively in FLD and 23.35, 25.24, 8.78 and 24.78 respectively in farmers practice. The percent fruitfly and leafminer incidence in ridge gourd was 15.7 and 18.0 during 2016-17 and 15.05 and 17.7 during 2017-18 respectively. The disease incidence was also shown similar trend in ridge gourd. Pawar *et al*, (2019) [8] recorded 21.15% leafminer damaged leaves and 10.84% fruitfly damaged fruits in integrated pest management module consists of first spray of *Metarhizium anisopliae* @ 5g/l at 30 DAS, yellow sticky traps @ 25/ha, cue lure traps @ 12/ha, spinosad 45SC@ 0.3ml/lit at 45 DAS, *Lecanicillium lecanii* @ 5g/l at 75 DAS in cucumber. Installation of cue lure baited traps @ 50 traps/ha, weekly clipping of infested fruits, foliar spray of aqueous leaf extracts of *Morinda citrifolia* @ 100g/l and foliar

spray of spinosad 45SC or imidacloprid 17.8 SL @ 0.3ml/lt alternatively recorded less damage due to fruitfly and maximum fruit yield in bitter gourd and ridge gourd [9]. In the present study also the integrated pest management components reduced the fruitfly and leafminer incidence than the farmer practice. The application of locally made botanical pesticide 'Jholmal' reduced the fruitfly infestation in summer squash and increased the fruit size, quality and yield [10].



Fig-1 Front Line Demonstration in bitter gourd



Fig-2 Front Line Demonstration in ridge gourd

The integrated management practices in bitter gourd recorded 26.4% yield increase during 2015 -16 and 17.6% and 16.93% yield increase in ridge gourd during 2016 -17 and 2017-18 respectively [Table-2]. The demonstration of IPM practices recorded benefit cost ratio of 3.40 with a net profit of Rs. 2,76,200/- in bitter gourd. In ridge gourd the BCR and net profit during 2016-17 and 2017 -18 was 2.60 and Rs. 71,900/- and 2.70 and Rs. 83,505/- respectively. The integrated pest management module viz., thiamethoxam 70WS @ 5-10g/kg of seed, removal of damaged cotyledonary leaves, spraying of emamectin benzoate 25WG @ 0.4g/lt, spraying of neem oil 3000ppm @ 5ml/lt, installation of cue lure traps @ 15/ acre, spraying of spinosad 45SC @ 0.3ml/l recorded highest yield (116.0 t/ha) and benefit cost ratio (2.61). The superiority of IPM module than the other methods has been reported by Gundannavar *et al.*, (2007) [11] in chillies, Tripathy *et al.*, (2013) [12] in onion and Shanmugam *et al.*, (2015) [13] in brinjal. The results of the present investigation corroborate with the above findings.

The technology gap which was derived based on the potential yield was 194q/ha for bitter gourd during 2015-16 and 133 q/ha and 79 q/ha in ridge gourd during 2016-17 and 2017-18 respectively. The technology index indicates the feasibility and performance of the demonstrated technology. The technology index for the present IPM demonstration for bitter gourd was 37.36 and for ridge gourd was 44.33 and 26.33 respectively during 2016-17 and 2017-18. The lower technology index for ridge gourd during the second year of FLD indicates the interest shown by the farmers in adopting the IPM technology in cucurbits. Sandeep kumar *et al.*, (2019) [14] in their study about integrated pest management practices against fruitfly in bitter gourd recorded 41.60% technology gap and 43.29% overall gap in

IPM practices adoption. Sangwan *et al.*, (2021) [15] recorded in their study on mustard cluster front line demonstration recorded technology index range of 39.8 to 42.1 per cent. The results of the present investigation fall in line with above findings.

Conclusion

The per hectare plant protection cost for IPM module and chemical control was Rs.12,240 and Rs.4040/- for bitter gourd and ridge gourd. Balaji *et al.*, (2016) [16] revealed that the farmers incur Rs. 11,250/ha towards plant protection expenditure in gourds. In the present investigation the farmers spent Rs.23,930 / ha in the integrated pest management module and Rs.31,000 / ha in farmers practice which is in contrary to the above findings [Table-4]. In the present investigation the hybrids were cultivated in drip fertigation which requires more input compare to conventional method. In the above studies the plant protection and cost of cultivation was calculated for varieties which requires less input compare to hybrids. Moreover, the farmers in this region are usually apply insecticide once in a week or fortnight based on the incidence of insect pest and disease to vegetables which ultimately increase the plant protection expenditure. The adoption of integrated pest management practices in bitter gourd and ridge gourd reduce Rs. 7,070/- in plant protection cost.

Application of research: The demonstration of integrated pest management to manage insect pest and diseases in cucurbits reduces the incidence of fruitfly, leafminer, mosaic and leaf spot and increases the yield. The expenditure incurred towards plant protection has to be reduced through sustained efforts.

Research Category: Front Line Demonstration

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Study area / Sample Collection: Dharmapuri district

Cultivar / Variety / Breed name: Bitter Gourd (*Momordica charantia* L.) and Ridge Gourd (*Luffa acutangula* (L.))

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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