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Evaluation of trellis system for pest management in bitter gourd

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ABSTRACT

To investigate the response of different trailing systems against insect pests of bitter gourd, a trial was conducted under field conditions for two consecutive years (2012-13 & 2013-14) in *rabi* season along with simultaneous assessment of their response on natural enemies. The findings clearly indicated that the fruit borer infested fruits was minimum in trellis system (12.19 and 13.57%) followed by non-trellis system (22.58 and 24.14%) followed by bower system (32.14 and 30.86%). Similar trend was also observed for fruit borer and fruit fly population during the same period. The maximum yield and highest cost:benefit ratio (138.07 q/ha and 1:7.25) was observed in trellis system. Regarding natural enemies, different trellis system showed positive response against coccinellids, spiders and grubs of chrysoprela. Fertilizer application, manual weeding, pesticide spraying insect pest monitoring and manual irrigation was found easier in trellis system. Highest cost:benefit ratio and least pesticide hazard due to drift was also found in trellis system.

Key words: *Momordica charantia,* melon fruit fly, pumpkin caterpillar, management, trellis system.

INTRODUCTION

Bitter gourd (*Mamordica charantia*; Cucurbitaceae), commonly known as balsam pear or *karela*, is cultivated throughout the world, especially in the tropical areas. It is a source of vitamins (B and C), minerals (iron, calcium and phosphorous), proteins and is highly effective in controlling the diabetes (Yuwai *et al*., 12; AVRDC, 3). Bitter gourd is attacked by different insect pests and melon fruit fly (*Bactrocera cucurbitae*) widely distributed in South Asian countries causes major economic loss (Vijaysegaran, 10). In recent time, pumpkin caterpillar (*Diaphania indica*) is also posing serious menace to this crop (George *et al*., 4; Anon, 2). Viraktamath *et al*. (11) found that this pest inflict heavy damage to many other cucurbits also. Young larva of this pest scrapes the chlorophyll content of leaves and later on it folds and webs and feeds within it. It also feeds on flowers and bores into developing fruits and causes economic loss by making holes and scratches on fruit surface rendering them unfit for marketing (Anon, 1).

Usually farmers cultivate bitter gourd under small production system on bower (*pandal*) trailing system on the basis of their age old knowledge. Growing on bower has its inherent restrictions to sunlight penetration resulting in high incidence of diseases, premature leaf falling and reduced fruit yield. Due to short height of trailing system, farmers execute cultural operations such as fertilizer application, spot irrigation in basin, and picking of fruits by bending under the bower system. The insecticides spraying in the interiors of bower system and keeping the direction of spray nozzles upward is also resulting in occupational health hazard. These problems require to be tackled by new technology on substitute systems of crop management. Keeping this in view, the present investigation was undertaken to develop suitable system that can overcome the above said problem.

MATERIALS AND METHODS

The present investigation was conducted at Vegetable Research Centre, Sabour, Bhagalpur, Bihar (latitude 87º 2´ 54"E, longitude 25º 14´ 24"N, altitude 30 amsl) under the All India Coordinated Research Project. The maximum temperature ranged between 30 to 36°C, minimum temperature between 17 to 25°C, maximum RH was 72 to 92% and minimum RH was 48 to 70% during the experimentation period. The trial was carried out with three treatments in a randomized block design in plots of 7.5 m × 7.5 m and replicated seven times. The spacing of row to row was 1.5 m and plant to plant is 50 cm. The experiment was conducted during summer seasons of 2012-13 and 2013-14. The seedlings of bitter gourd variety Pusa Do Mausami were raised as per the recommended package of practices except insect-pest management practices. The three different trellis systems, *viz*., farmers traditional bower, trellis and non-trellis were studied. In bower (*pandal*) system, bitter gourd vines are allowed to rise on vertical trellises in the beginning and afterwards these vines extend on top and cover the entire area. The top of adjacent

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trellises were inter-connected with the help of gunny threads or thin wires secured with poles and wires. The vines are allowed to rise along this network to completely cover the entire top area in due course of time. In trellis system, the vines are trailed on vertical trellises only and top of the area remained open to permit full penetration of light and free passage of air (Singh *et al*., 9). In trellis system, wooden poles were fixed at 8 m distance in each row and four rows of 14 gauge thick wires was tied up at every 40 cm height of poles. The height of trellis was maintained at 165 cm (Palada and Chang, 8). To create the awareness among the farmers a scale was adapted in third year and perception of 20 farmers of three villages in Bhagalpur district about the performance of trellis system was also evaluated (Singh *et al*., 9).

Observations on per cent fruit borer infestation, larval population of pumpkin caterpillar, fruit yield and incremental cost: benefit ratio (ICBR) were recorded. The incidence of fruit flies both in number and weight basis was recorded in all systems. Simultaneously, natural enemy complex was also assessed in all systems. Data obtained were subjected to analysis of variance (ANOVA) after appropriate transformation according to Gomez and Gomez (5).

RESULTS AND DISCUSSION

Minimum fruit infestation (12.19 and 13.57%) was recorded with trellis system followed by non-trellis system (22.58 and 24.14%) and bower system (32.14 and 30.86%) (Table 1). Similarly, fruit borer population was recorded to be minimum in trellis system (0.76 and 0.84) followed by non-trellis system (1.01 and 1.10) and bower system (1.26 and 1.34). Present results clearly indicated that the pest density was significantly higher in bower system as compared to trellis and non-trellis systems. One of the reasons for this type of infestation may be inclination of the pest for egg laying on horizontal surface available more in bower system. Thus, the trellis system had significantly low number of larvae naturally. The present results are in conformity with the earlier finding of Singh *et al*. (9), where they reported that fruit infestation due to fruit borer was significantly higher in bower system and minimum in trellis system. Nair (7) also reported significantly higher fruit loss in bower system followed by double and single line trailing systems.

Fruit fly infestation (Table 2) based on total number of fruit was lowest (8.81 and 6.94%) in trellis system followed by non-trellis system (15.87 and 13.93%) and bower system (24.71 and 26.14%). Similar trends were also recorded in fruit infestation based on weight basis (trellis system < non-trellis system < bower system). Based on the results, it is clear that trellis system was most effective in reduction of fruit fly infestation than other systems. On the other side, it reflected that bower system had maximum fruit fly population. It has been found that, fruit flies choose to relax in dark and shaded foliage and bower system provides such conditions more compared with trellis system. In addition, the

Table 1. Effect of different trellis system on fruit borer infestation in bitter gourd.

Treatment	Fruit borer infestation		Fruit borer population*	
	Per cent fruit loss (No. basis)		Population of *D. indica* /fruit	
	2012-13	2013-14	2012-13	2013-14
Non-trellis	22.58 (28.34)*	24.14 (29.35)	1.01 (1.22)**	1.10 (1.25)
Trellis	12.19 (20.35)	13.57 (21.49)	0.76 (1.11)	0.84 (1.15)
Bower	32.14 (34.49)	30.86 (33.63)	1.26 (1.32)	1.34 (1.35)
CD at 5%	2.78	4.23	0.12	0.20

*Figures in parentheses are Arc-Sine transformed values, **Figures in parentheses are √x transformed values.

Table 2. Effect of different trellis system on fruit fly infestation in bitter gourd.

Treatment	Per cent fruit loss (No. basis)		Per cent fruit loss (weight basis)	
	2012-13	2013-14	2012-13	2013-14
Non-trellis	15.87 (23.23)	13.93 (21.78)	14.51 (22.31)	16.86 (23.92)
Trellis	8.81 (17.00)	6.94 (15.07)	7.77 (15.77)	9.51 (17.80)
Bower	24.71 (29.72)	26.14 (30.71)	23.29 (28.74)	28.71 (32.35)
CD at 5%	5.01	3.26	4.77	4.06

*Figures in parentheses are Arc-Sine transformed values.

larvae pupated in soil under bower system did not go out due to crop obstacle and infest the available fruits inside the systems. In bower system, most of the bitter gourd fruits are highly exposed and hang without any protection from foliage, whereas, in trellis system most of the fruits remain partially hidden inside the foliage leading to less infestation by fruit fly. The present findings are in line with the findings of Singh *et al*. (9), *i.e.*, the fruit loss in terms of number and weight was significantly lower in trellis system as compared to other two systems. Earlier, Jiji *et al*. (6) reported that fruit flies have been more active at a height of 1.36 m from ground level and in bower and double line trellis system most of the fruits hang uniformly at a height of nearly 1.5 m but in single line the fruits remain uniformly distributed on the entire vertical surface of trellis system.

The different trellis systems in response to natural enemy complex was one of the important factors to be taken into account (Table 3). All the system showed positive response to natural enemies. In all the systems, coccinellids, spiders and chrysoperla grub population varies between 1.91 to 2.29, 1.86 to 2.43 and 0.93 to 1.14, respectively. Hence, it clearly shows that all the systems are favourable for coccinellids, spiders and chrysoperla grubs.

The data (Table 4) indicated that among the different system, trellis system recorded maximum (138.07 q/ha) yield followed by non-trellis system (117.64 q/ha) and bower system (90.14 q/ha). The cost-benefit ratio was 1:7.25 in trellis system followed by 1:5.25 in non-trellis system and 1:4.03 in bower system. The present experiment clearly demonstrated that the trellis system resulted in maximum yield and highest benefit:cost than other systems. One of the reasons for reduction in yield in bower system might be most of the leaves in the interiors of this system fell prematurely due to heavy incidence (30-40%) of downy mildew resulting in reduced yield compared to trellis system. In addition, damage to the flowers and buds are more due to pest infestation and contributed in yield reduction under bower system. The present investigations are in conformity with Singh *et al*. (9) as they reported that maximum fruit yield was recorded in trellis system as compared to bower system.

Table 3. Effect of different trellis systems on natural enemy complex in bitter gourd (pooled over years).

Treatment	Coccinellids/ vine	Spider/ vine	Chrysoperla grubs/ vine
Non-trellis	2.29 (1.64)*	2.43 (1.69)	1.14 (1.27)
Trellis	2.14 (1.60)	1.86 (1.51)	1.06 (1.24)
Bower	1.91 (1.51)	2.06 (1.58)	0.93 (1.19)
CD at 5%	0.39	0.30	0.24

*Figure in parentheses are √x transformed values.

Table 4. Yield and economics of marketable gourd under different trailing systems.

Treatment	Yield of bitter gourd (q/ha)		Mean	ICBR
	2012-13	2013-14		
Non trellis	114.86	120.43	117.64	5.25
Trellis	131.43	144.71	138.07	7.25
Bower	93.71	86.57	90.14	4.03
CD at 5%	25.92	17.64	-	-

The farmers' awareness pertaining to trailing system has been presented in Table 5. Farmers understood the benefits of trailing system as compared to bower system and their own traditional method after visiting the experimental trial. In trellis system, air and light easily filter through the fence which improves ventilation and ambiance and also low insect pests and disease problems. They found

Table 5. Benefits by growers in installing of trellis system in bitter gourd (n = 20).

Type of benefits understanding	Per cent farmers accepted
Incidence of fruit fly and fruit borer is less in trellis system compared to bower and non trellis system	90.00
Incidence of powdery and downy mildew is less in trellis system compared to bower and non trellis system	85.00
Easy to do manual irrigation, fertilizer application and weeding in trellis system	80.00
The cost of trellis system is less as compared to bower system	95.00
Pesticide application is easy in trellis system as compared to bower system. Another benefit is least body exposure to pesticide drift in trellis system.	90.00
Observation of crops in terms of insect pest damage and crop health is easy in trellis system as compared to bower system.	85.00

that the lesser incidence of diseases (downy mildew) and insects (fruit fly and fruit borer) in trellis system as compared to other two systems. Furthermore, application of fertilizers, plant growth regulators, manual weeding, pesticide spray and irrigation was easy in trellis system as compared to other systems.

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REFERENCES

1. Anonymous, 2005. Postharvest management of fruit and vegetables in the Asia-Pacific region. **In**: *Marketing and Food Safety: Challenges in Postharvest Management of Agricultural/ Horticultural Products in Islamic Republic of Iran*, 23–28 July 2005. APO 2006, ISBN: 92-833-7051-1, 312 p.
2. Anonymous, 2005. Semi structured farmers interview of bitter gourd growers in Khurda. *Annual Report. Integrated Management of Fruit flies In India-DFID*. Central Horticultural Experiment Station, Bhubaneswar, 71 p.
3. AVRDC-Vegetable Genetic Resources Information System (AVGRIS). 2005. *AVRDC-The World Vegetable Center, Shanhua, Tainan,Taiwan*. Website: http://203.64.245.173/avgris/.
4. George, S., Singh, H.S. and Naik, G. 2002. Participatory approaches for management of pumpkin caterpillar (*Diaphania indica*) in bitter gourd. *J. Ext. Edu*. **7**: 68-75.
5. Gomez, K.A. and Gomez, A.A. 1984. *Statistical Procedures for Agricultural Research*, John Wiley and Sons, New York.
6. Jiji, T., Tamilvel, D., Stonehouse, J.M., Mumford, J.D. and Verghese, A. 2005. Attraction of melon flies by lure blocks at different heights and orientations in Kerala. *Pest Mgmt. Hort. Ecosyst*. **11**: 164.
7. Nair, M.R.G.K. 1995. *Insects and Mites of Crops in India,* Indian Council of Agricultural Research, New Delhi, 163 p.
8. Palada, M.C. and Chang, L.C. 2003. *Suggested Cultural Practices for Bitter gourd*, AVRDC Pub. No. 03-547, 2 p.
9. Singh, H.S., Pandey, V., Naik, G. and Vishal, N. 2007. Developing trellis system for efficient pest control in bitter gourd under coastal ago-ecosystem of Orissa. *Veg. Sci.* **34**: 140-44.
10. Vijaysegaran, S. 1997. Combating fruit fly problem in Malaysia. **In**: *The Current situation and strategies to overcome the existing problem*. Selangor Malaysia, ASEAN *Plant Quar. Tr. Inst*., pp. 209-216.
11. Viraktamath, C.A., Mallik, P., Chandrashekar, S.C., Ramakrishana, B.V. and Praveen, H.M. 2003. Pests and diseases of gherkins and their management. M.Sc. thesis, University of Agricultural Science, Bangalore, pp.1-23.
12. Yuwai, K.E., Sunder, R.K., Kaluwin, C., Jones, G.P. and Rivett, D.E. 1991. Chemical compositions of *Momordica charantia* L. fruits. *J. Agric. Food. Chem.* **39**: 1762-63.

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