DOI: 10.15740/HAS/AU/9.3/320-326
Agriculture Update
Volume **9** | Issue 3 | August, 2014 | 320-326 |
Visit us : *www.researchjournal.co.in*
e ISSN-0976-6847

Research Article

Bitter gourd growers pesticides use pattern in controlling insect-pests and diseases in Nadia district of West Bengal

HIRALAL JANA

ARTICLE CHRONICLE :
Received :
16.05.2014;
Revised :
03.06.2014;
Accepted :
19.06.2014

SUMMARY : Indiscriminate use of chemicals in agriculture during post green revolution period and their adverse effect on soil health and environment has created an alarming situation. A situation has resulted which urgently demands an environmentally safe, sustainable and simultaneously, economically viable production system. This indeed is essential for optimizing production and at the same time to minimize threat to environment. Considering the importance of the study, the objective, to portray the pesticides use pattern in bitter gourd in controlling insect-pests and diseases was undertaken. The study was conducted in Nadia district of West Bengal. For the selection of area and respondents of the present study, multi-stage random sampling technique and universe method were adopted. The study reveals that the most harmful insect-pest of bitter gourd crop was pumpkin fruit fly, downy mildew disease was the most damaging disease, bitter gourd growers were using various brands of various technical grade of pesticides for controlling insect-pests and diseases with several doses, infestation of insect-pests and diseases was mainly seen on mature stage of the crop, main source of information on pesticides use was agricultural input retailers, the bitter gourd growers used 40-60 lit. and 60-90 lit. of water per bigha of land (1 acre=3 bighas) for spraying at seedling stage and mature stage, respectively, their interval of spraying of chemicals was mainly 4-7 days and spraying was most popular method of application of pesticides. Therefore, on the basis of the present investigation, the various extension agencies those are working in the study area should reorient their extension strategies accordingly.

KEY WORDS :
Pesticides, Chemical name, Commercial name, Use pattern, Bitter gourd growers, Insect-pests, Diseases, Sustainable agriculture

How to cite this article : Jana, Hiralal (2014). Bitter gourd growers pesticides use pattern in controlling insect-pests and diseases in Nadia district of West Bengal. *Agric. Update,* **9**(3): 320-326.

Author for correspondence :
HIRALAL JANA
Department of Extension Education, N.M. College of Agriculture, Navsari Agricultural University, NAVSARI (GUJARAT) INDIA
Email: janahiralal@yahoo.in

BACKGROUND AND OBJECTIVES

The country is home to one-sixth of mankind and the population has reached 121.1 crores. Facing the task of feeding the geometrically expanding population, agricultural development is very essential in India's perspective. Food security, nutritional security, sustainability and profitability are the main focus of present and future agricultural development (Pandian, 2011). Considering the rising incomes due to rapid economic growth, it is estimated that by 2020 and 2050 the foodgrains requirement is likely to be 297 and 450 million tonnes, respectively. In real terms the foodgrains availability per person /day has actually declined from 510 g in 1991 to 462.9 g in 2011. Therefore, the nutritional status of Indian population is a critical issue (Agarwal, 2013). Vegetables are so common in human diet that a meal without vegetable is supposed to be incomplete in any part of the world. Vegetables provide proteins, carbohydrates, minerals, vitamins and roughages which constitute the essential of balanced diet (Ram *et al.*, 2012). The bitter gourd (*Momordica charantia*) is grown extensively throughout India. The fruits are cooked in many ways and are quite commonly used fried, boiled, stuffed and cooked

and also in curries. The bitter taste is liked by some and is supposed to contain some medicinal properties. The small varieties are rich in iron and vitamins. The lower yields are attributed to infestation of the crops by insect-pests and diseases and non-adoption of plant protection measures by farmers (Bhalekar *et al.*, 2013). Among the all measures to raise the productivity level, plant protection is in central position. Plant protection is a basic exercise in any crop for control of insect-pests, diseases, weeds etc. to avoid economic losses. Reports indicate these losses ranging from 20-30 per cent by each of the insect-pests, diseases and weeds, but on a holistic basis about 30 per cent average cumulative loss by them appears a fair estimate. This implies that suitable control measures must be followed to keep these losses to the minimum (Muthuraman and Kumar, 2013). Farmers' use behaviour of pesticides in vegetables is so dynamic which requires regular research Agarwal *et al*. (1987); Atwal (1986) and Bhatnagar and Yadav (1992) . Considering the importance of the study, the objective, to portray the pesticides use pattern in bitter gourd in controlling insect-pests and diseases was undertaken.

RESOURCES AND METHODS

The study was undertaken in the state of West Bengal. For the selection of area and respondents of the present study, multi-stage random sampling technique and universe method were adopted. At the first stage of sampling, Nadia district was selected among the 18 agricultural districts of the state purposively based on its' higher area coverage in vegetable cultivation. Out of 16 blocks of Nadia district, one block (*i.e.* Chakdah) was randomly selected at the second stage of sampling. In the selected block (Chakdah) a relatively homogenous field cultivated with vegetable crops was chosen on the basis of the opinion of the agricultural input retailers. The farmers who were growing bitter gourd in that field were selected as respondents of the present study through total enumeration. Thus, total 100 farmers ultimately considered as respondents of the study. The data were collected by personal interview method by using local language (Bengali) for getting their exact response and simple percentage method was used for analysis of data statistically to reach at meaningful results and conclusion.

OBSERVATIONS AND ANALYSIS

The experimental findings obtained from the present study have been discussed in following heads:

Land:

Majority of respondents (69%) had upto 10 kathas (1 Bigha=20 kathas) of land (Table 1) under bitter gourd cultivation whereas 22 per cent of respondents had 10-20 kathas of land and remaining 9 per cent of them had 1-2 bighas of land under this crop.

Season:

Bitter gourd is a round the year crop. At the most 40 per cent of respondents cultivated the crop in *Kharif* season whereas 36 per cent of them cultivated it in *Rabi* season and remaining 24 per cent of growers cultivated it in pre- *Kharif* season.

Insect-pests:

All the respondents (100%) had the problem (Table 2) due to pumpkin fruit fly whereas 77 per cent of respondents had the problem of red pumpkin beetle, 41 per cent of them had problem of mite whereas 23 per cent of respondents had the problem of pumpkin caterpillar.

Pumpkin fruit fly (*Dacus cucurbitae*):

For cucurbits, especially bitter gourd, *Momordica charantia* Linn., the melon fruit fly damage is the major limiting factor in obtaining good quality fruits and high yield (Srinivasan, 1959; Lall and Singh, 1969; Mote, 1975; Rabindranath and Pillai, 1986).

Table 1: Land holding possessed by respondents under bitter gourd cultivation and season of cultivation

Sr.No.	Land holding (Kathas/Bighas)	Per cent of respondents possessed	Season of cultivation	Per cent of respondents cultivated
1.	10 kathas	69	*Pre-kharif*	24
2.	10-20 kathas	22	*Kharif*	40
3.	1-2 bighas	9	*Rabi*	36

Table 2: Insect-pests and diseases of bitter gourd

Insect-pests	Percentage of respondents reported	Diseases	Percentage of respondents reported
Pumpkin fruit fly	100	Downy mildew	100
Red pumpkin beetle	77	Cercospora leaf spot	47
Mite	41	Leaf curl	19
Pumpkin caterpillar	23		

The insect-pest infestation was seen in mature stage of the crop. The maggots bore into the fruits and feed on the pulpy tissues inside, forming galleries (Narayanan, 1953). They attack fruits are polluted and destroyed. The affected fruits start rotting. The fly attack is severe after summer rains when the humidity is high. The flies are reddish brown with lemon yellow curved verticle markings on the thorax. The female has conical abdomen ending in a ovipositor while male has

Table 3 : Insect-pests and diseases of bitter gourd and the chemicals used to control

Pest problem	Chemicals used	Percentage of respondents used	Pest problem	Chemicals used	Percentage of respondents used
Insect-pests			Insect-pests		
Pumpkin fruit fly	Confidor	21	Pumpkin Caterpillar	Force	12
	Challenger	16		Dursban	6
	Tagban	10		Metacid	8
	Metacid	8		Ekalux	3
	Cymbush	12		Thiodan	7
	Suquin	18		Challenger	10
	Suphos	14		Suquin	11
Red pumpkin beetle	Sumidon	22	Diseases		
	Ekalux	10	Downy mildew	Dithane-M 45	72
	Hostathion	13		Krilaxyl	7
	Metacid	17	Cercospora leaf spot	Dithane-M 45	63
	Cymbush	21		Krilaxyl	12
	Challenger	12		Cyvistin	7
	Ustad	30	Leaf curl	Dithane-M 45	27
	Tarjan	14		SAAF	12
Mite	Dicofol	32		Krilaxyl	20
	Colonel-S	8		Indifil-M-45	24
	Thiodan	12		Companion	11
	Met505	9			

Table 4 : Various pesticides and their doses

Pesticides used	Dose: ml/lit. of water	Pesticides used	Dose: ml or g per lit. of water
Insecticides			
Sumidon	2.00 ml	Confidor	0.40 ml
Ekalux	1.50 ml	Force	1.50 ml
Suquin	2.00 ml	Dursban	2.00 ml
Metacid	2.00 ml	Suphos	2.00 ml
Metacid	1.50 ml	Tagban	2.00 ml
Metacid	1.00 ml	Hostathion	2.00 ml
Ustad	2.50 ml	Cymbush	2.00 ml
Tarjan	2.00 ml	Fungicides	
Dicofol	1.00 ml	Dithane-M 45	2.50g
Colonel-S	1.00 ml	SAAF	2.00g
Thiodan	2.00 ml	Krilaxyl	2.50g
Met 505	1.50 ml	Indifil-M-45	2.00g
Challenger	1.00 ml	Companion	2.50g
Challenger	3.00 ml	Cyvistin	2.00g
Challenger	1.50 ml		

spherical abdomen. Wings are transparent with brown bands and grey spots at the apex between the joint of thorax and abdomen. The maggots are legless and appear headless, dirty white wriggling creatures, thicker at one end and tapering to a point at the other. The female fly punctures the fruit and deposits the eggs inside the pulp. The various chemicals used by the respondents for controlling the insect-pest, their doses and per cent of respondents replied were as follows (Table 3 and 4), confidor @ 0.4ml/litre of water (21%), challenger@ 1ml/lit. of water (16%), tagban @ 2ml/lit. of water (10%) and metacid @ 2ml/lit. of water (8%), cymbush @ 2ml/lit. of water (12%), suquin @ 2ml/lit. of water (18%), suphos @ 2ml/lit. of water (14%). The water used by the bitter gourd growers for spraying the chemicals at the mature stage of the crop was 60-90 lit. per bigha of land (Chaudhary and Patel, 2007 and Dhillon *et al.*, 2005).

Red pumpkin beetle (*Aulacophora foveicollis*):

It was seen in all stages of the crop. The grubs damage the plants by boring into the roots, underground stems and sometimes fruits touching the soil. The adult beetles feed on the foliage, buds and flowers. Singh *et al.* (2006) reported that the major insect pests of bitter gourd are fruit fly and red pumpkin beetle. Red pumpkin beetle is the most destructive inset pest of cucurbitaceous. Rahaman and Prodhan (2007); Rahaman *et al.* (2008). They make holes in the leaves of young seedlings. The early sown bitter gourd suffers most from this pest. The grubs are creamy white with a slightly darker oval shield at the back. They are 12 mm in length. The beetles are oblong with brilliant orange-red colour. The ventral surface is black and covered with short soft white hair. The grubs and the adult beetles scrap the leaves in a characteristic manner and feed upon them. The affected leaves are typically skeletonised. Adult beetles have six black spots on each elytron whose tip is more rounded. The various chemicals used by the respondents for controlling the insect-pest, their doses and per cent of respondents replied were as follows (Table 3 and 4), sumidon @ 2 ml/lit. of water (22%), ekalux @ 1.5ml/lit. of water (10%), hostathion @ 2ml/lit. of water (13%), metacid @ 1ml/lit. of water (17%) cymbush @ 2ml/lit. of water (21%), challenger @ 3ml/lit. of water (12%), ustad @ 2.5 ml/lit. of water (30%) and tarjan @ 2ml/lit. of water (14%). In seedling

Table 5: Various pesticide brands and their chemical names

Pesticide brands	Chemical/technical names	Pesticide brands	Chemical/technical names
Insecticides		Confidor	Imidachlorprid
Sumidon	Phosphamidon	Dursban	Chloropyriphos
Ekalux	Quinalphos	Tagban	Chloropyriphos
Hostathion	Triazophos	Force	Chloropyriphos
Metacid	Methyl Parathion	Suquin	Quinalphos
Cymbush	Cypermethrin	Suphos	Monocrotophos
Challenger	Cypermethrin	Fungicides	
Ustad	Cypermethrin	Dithane-M 45	Mancozeb
Tarjan	Triazophos	SAAF	(Carbendazim+Mancozeb)
Dicofol	Dicofol	Krilaxyl	Metalaxyl
Colonel-S	Dicofol	Indifil-M-45	Mancozeb
Thiodan	Endosulfan	Companion	(Carbendazim+Mancozeb)
Met 505	Ethion	Cyvistin	Carbendazim

Table 6: Insect-pests and diseases, their attacking stage and amount of water used for spraying

Pests	Attacking stage of crop	Water used for spraying/bigha of land	
Insect-pests		Seedling stage	Mature stage
Pumpkin fruit fly	Mature stage		60-90 lit.
Red pumpkin beetle	All stage	40-60 lit.	60-90 lit.
Mite	Mature stage		60-90 lit.
Pumpkin caterpillar	All stage	40-60 lit.	60-90 lit.
Diseases			
Downy mildew	Mature		60-90 lit.
Cercospora leaf spot	Mainly mature stage		60-90 lit.
Leaf curl	Mature stage		60-90 lit.

stage of the crop the rate of application of water for spraying was 40-60 lit./bigha, whereas in mature stage it was 60-90 lit./ bigha.

Mite (*Tetranychus necocaledonicus*):

It was seen mainly in mature stage of the crop. These are small insects and appear in large colonies. They feed on the under surface of the leaves by sucking cell sap. They remain protected by fine shinning webs. The affected leaves develop greyish patches and finally dry up. This is a minor pest and is found in colonies under the leaf surface. They feed by sucking the sap. The infected leaves curl and dry up. The various chemicals used by the respondents for controlling the insect-pest, their doses and per cent of respondents replied were as follows (Table 3 and 4), dicofol @ 1ml/lit. of water (32%), colonel-S @ 1ml/lit. of water (8%), thiodan @ 2ml/lit. of water (12%) and met 505 @ 1.5ml/lit. of water (9%), amount of water used by the respondents for spraying the chemicals at the mature stage of the crop was 60-90 lit. per bigha of land.

Pumpkin caterpillar (*Palpita indica*):

It was seen all stages of the crop. The larvae feed on the lower surface of the leaves and they bind them together with the help of silken threads exuding from the mouth of larvae. They also attack the ovaries of flowers and bore the young developing fruits which become unfit for human consumption. The moths have white wings with dark brown marginal patches. Caterpillars are bright green. The various chemicals used by the respondents for controlling the insect-pest, their doses and per cent of respondents replied were as follows (Table 3 and 4), force @ 1.5ml/lit. of water (12%), dursban @ 2ml/lit. of water (6%), metacid @ 1.5ml/lit. of water (8%), ekalux @ 1.5ml/lit. of water (3%), thiodan @ 2ml/lit. of water (7%), challenger@1.5ml/lit. of water (10%) and suquin @ 2ml/lit. of water (11%). The water used by the growers for spraying the chemicals were 40-60 lit. and 60-90 lit. per bigha of land in seedling stage and mature stage of the crop, respectively.

Diseases:

Table 2 indicates that all the respondents (100%) had the problem of downy mildew disease whereas 47 per cent of them identified Cercospora leaf spot disease as important one and only 19 per cent of vegetable growers noticed about leaf curl disease of bitter gourd.

Downy mildew disease (*Pseudoperenospora cubensis*):

It was seen in mature stage of the crop. The spots are yellow, angular and often restricted by the veins on the upper surface of the leaves. On the lower surface of these spots, the purplish downy growth appears during periods of high humidity. Sometimes the purplish colour is lacking and the lower side of the spots looks white to almost black. Phookan and Gogoi (1995). worked on the occurrence of downy mildew on bitter gourd and Pandey *et al.* (2001) on cauliflower. The entire leaf dies quickly. The fruits are few and smaller than the healthy ones with poor tastes. The fungus survives as mycelium and spores on some hosts. The various chemicals used by the respondents for controlling the disease, their doses and per cent of respondents replied were as follows (Table 3 and 4), dithane M-45 @ 2.5g /lit. of water (72%) and krilaxyl (Metalaxyl+Mancozeb) @ 2.5g /lit. of water (7%), respectively. The amount of water needed for spraying at the mature stage of the crop was 60-90 lit. per bigha of land.

Cercospora leaf spot (*Cercospora citrullina*):

It was seen mainly in mature stage of the crop. The characteristic symptoms are the appearance of water soaked areas on the leaf lamina. These spots enlarge rapidly to become circular to irregular spots with pale brown, tan or white centres and wide purple to almost black margins. Many spots may coalesce to form bloches. The leaf may dry and finally die. The fungi perpetuate on the perennial weeds and on the diseased crop debris. Majority of respondents (63%) used dithane M-45 @ 2.5g /lit. of water for controlling the disease whereas 12 per cent of them used krilaxyl @ 2.5 g/lit. of water and only 7 per cent used cyvistin @ 2.0g /lit. of water. The amount of water applied by the respondents for spraying of chemicals at the mature stage of the crop was 60-90 lit./bigha of land.

Leaf curl:

It was seen in mature stage of the crop. The chief symptom of the disease is curling of leaves as reported by the respondents. The various chemicals used by the respondents for controlling the disease, their doses and per cent of respondents replied were as follows (Table 3 and 4), dithane M-45 @ 2.5g /lit. of water (27%), SAAF @ 2.0g /lit. of water (12%), krilaxyl @ 2.5g /lit. of water (20%),

Table 7: Interval of applying pesticides and method of application of pesticides

Days of Interval	Percentage of respondents followed	Methods of application of pesticides	Percentage of respondents followed
1-3	21	Spraying	100
4-7	53	Dibbling	41
8-15	17	Dusting	11
Above 15	9		

indofil M-45 @ 2.0g /lit. of water (24%) and 11 per cent of respondents used companion 2.5 g/lit. of water. The amount of water used by the respondents for spraying the chemical at the mature stage of the crop was 60-90 lit. per bigha.

Interval of applying pesticides:

Respondents in the study area (Table 7) preferred to apply pesticides in the following days' interval-1-3 days (21%), 4-7 days (53%), 8-15 days (17%) and more than 15 days (9%).

Methods of applying pesticides:

All the respondents in the study area (100%) applied pesticides mainly through spraying whereas 41 per cent of bitter gourd growers followed dibbling method (digged the soil and the pesticides were inserted and filled the hole by soil again especially application of granular pesticides) and only 11 per cent of selected farmers also applied the chemicals by following dusting method.

Source of information in using pesticides:

All the respondents (100%) reported that they mainly got information in using pesticides from agricultural input retailers at the time of purchasing. About one-third of respondents (32%) collected information from fellow farmers and it was very traditional way of getting information. In the study area, it was seen that a crop doctor had a frequent contact with the farmers and supplied valuable information pertaining to agricultural problems. Twenty two per cent of respondents replied that they got information from crop doctor whereas 18 per cent of farmers collected information from neighbour (farming community) and 21 per cent of respondents collected it from big farmers (opinion leaders). Only 7 per cent of respondents' source of information was relatives whereas 11 per cent of respondents collected that information from Agricultural Development Officers (ADOs), Krishi Prayukti Sahayaks (KPSs) when any demonstration organized by them, experts of agricultural university (when farmers came to participate any agricultural training programme or personally contacted from experts), company personnel or other agricultural field functionaries (Table 8). After collecting the information from various sources, each respondent evaluated it in their level best and finally applied the suitable one. George *et al.* (2002) and Singh *et al.* (2007).

Table 8: Sources of information on pesticides' use

Source	Percentage of respondents collected
Agricultural input retailers	100
Fellow farmers	32
Crop doctor	22
Neighbour	18
Big farmers	21
Relatives	7
ADOs, KPSs, Experts of Agril. University, company personnel, other agricultural field functionaries	11

Conclusion:

Cultivation of high yielding varieties and hybrids of cereals have put a great pressure on soil and water resources. Vegetable cultivation has aggravated this problem because intensive cultivation of these crops require heavy doses of fertilizers and various kind of chemicals to protect the crops from insect-pests, diseases, weeds, nematodes and other pests. Therefore, to reduce the detrimental effects of these chemicals on environment, it is urgent to know the pesticides use pattern of farmers for each crop. Considering these, the present investigation was carried out. It can be concluded from the study that bitter gourd growers should give more emphasis on controlling insect-pest of pumpkin fruit fly and downy mildew disease, those damage the crop mostly. Bitter gourd growers were using various brands of various technical grades of pesticides for controlling insect-pests and diseases with several doses where it is generally seen that the farmers used chemicals and their doses varied from recommendations. Therefore, they must try to follow recommendations those are well tested for various situations as well as provide optimum results. Farmers must also follow various precautions in using pesticides. Precautions are so integratedly related with pesticides application that are can say, pesticides application and following various precautions are two sides of a coin. Following precautions are essential in respect of sustainability concern. The bitter gourd growers main source of information in using pesticides were agricultural input retailers, because the growers purchase the chemicals from them, at the time of purchasing, growers get advice and instructions to use the purchased chemicals as well as retailers are mainly local people in rural areas, therefore, they are believable to them. On the other hand, agricultural input retailers consider the farmers who purchase chemicals from them as customers of their business, therefore, survival of customers (farmers) means survival of their business means their betterment. Therefore, agricultural input retailers always try to co-operate the farmers in farming upto a maximum extent though they are business minded. Since, time has come to consider agricultural input retailers as one of stakeholders of agricultural development of our country. Therefore the Govt. extension agencies should have a special attention on this section of society. In the study area, spraying was the mostly followed method of application of pesticides compared to dibbling method and dusting method, therefore, pesticides manufacturers should have more emphasis on liquid chemicals production. The growers interval of applying pesticides was mainly 4-7 days. More than half of

respondents (53%) applied chemicals following the 4-7 days interval as a routine work. Farmers should refrain from this use behaviour and pesticides only be applied to the crop when insect-pests attack crosses the economic threshold level (ETL), otherwise it is harmful to sustainability concern as well as reduces the profit margin. Therefore, on the basis of the findings of the present investigation, the govt. extension agencies, pesticides companies and private extension agencies should reorient their extension programmes accordingly.

REFERENCES

Agarwal, M.L., Sharma, D.D. and Rahman, O. (1987). Melon fruit fly and its control. *Indian Hort.,* **32**: 10-11.

Agarwal, R.G. (2013). Expanded crop protection for assured food and nutritional security: *Pestology*, **37** (9): 14-16.

Atwal, A.S. (1986). *Agricultural pests of India and South-East Asia*. Kalyani Publishers, NEW DELHI, INDIA.

Bhalekar, M.D., Sidam, V.N., Bondarwad, S.P. and Lad, A.S. (2013). Constraints in adoption of biological pest management practices in cotton in Vidarbha region; *Agric. Update*, **8** (1&2):70-72.

Bhatnagar, K.N. and Yadava, S.R.S. (1992). An insecticidal trial for reducing the damage of some cucurbitaceous fruits due to *Dacus cucubitae* Coq. *Indian J. Entomol.*,**54**: 66-69.

Chaudhary, F.K. and Patel, G.M. (2007). Biology of melon fly, *Bactrocera cucurbitae* (Coq.) on pumpkin. *Indian J. Entomol.,* **69**(2): 168-171.

Dhillon, M.K., Singh, R., Naresh, J.S. and Sharma, H.C. (2005). The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. *J. Insect Sci.,* **5**: 40.

George, S., Singh, H.S. and Naik, G. (2002). Participatory approaches for management of pumpkin caterpillar (*Diaphania indica*) in bitter gourd. *J. Extn. Edu.,* **7**(1&2): 68-75.

Lall, B.S. and Singh, B.N. (1969). Studies on the biology and control of melon fly, *Dacus cucurbitae* (Coq.) (Diptera: Tephritidae). *Labdev J. Sci.& Tech.,* **7B**: 148-153.

Mote, U.N. (1975). Control of fruit fly (*Dacus cucurbitae*) on bitter gourd and cucumber. *Pesticides,* **9**: 36-37.

Muthuraman, P. and Kumar, S.A. (2013). Crop growth stage-wise IPM practices in rice. *Kisan World,* **40** (4): 57-59.

Narayanan, E.S. (1953). Seasonal pests of crops. *Indian Farming*, **3** (4): 8-11 & 29-31.

Pandey, K.K., Pandey, P.K., Singh, B., Kalloo, G. and Kapoor, K.S. (2001). Sources of resistance to downy mildew (*Peronospora parasitica*) disease in Asiatic group of cauliflower. *Veg. Sci.,* **28**(1): 55-57.

Pandian, P.S. (2011). Application of nanotechnology to plant nutrition. *Readers Shelf*, **7** (7):4-5.

Phookan, A.K. and Gogoi, R. (1995). Occurrence of downy mildew on bitter gourd in Assam. *Indian J. Mycol. Pl. Path.,* **25**(3): 331.

Rabindranath, K. and Pillai, K.S. (1986). Control of fruit fly of bitter gourd using synthetic pyrethroids. *Entomol.,* **11**: 269-272.

Rahaman, M.A. and Prodhan, M.D.H. (2007). Effects of net barrier and synthetic pesticides on red pumpkin beetle and yield of cucumber. *Internat. J. Sustain. Crop Prod.,* **2**(3): 30-34.

Rahaman, M.A., Prodhan, M.D.H. and Maula, A.K.M. (2008). Effect of botanical and synthetic pesticides in controlling *Epilachna* beetle and the yield of bitter gourd. *Internat. J. Sustain. Crop Prod.,* **3**(5): 23-26.

Ram, D., Prasad, A., Sahu, R.P. and Chanu, T.M. (2012). Comparative profile of entrepreneurial behaviour of vegetable growers in Manipur: *J.Interacademicia*, **16** (4a): 1015-1022.

Singh H.S., Pandey, V., Naik, G. and Nath, Vishal (2007). Developing trellis system for efficient pest control in bitter gourd under coastal agro- ecosystem of Orissa. *Veg. Sci.,* **33**(2) 203-205.

Singh, N.P., Singh, D.K., Singh, Y.K. and Kumar, V. (2006). Vegetables seed production technology, 1st Ed. International Book Distributing Co., Lucknow (U.P.) INDIA.

Srinivasan, P.M. (1959). Guard your bitter gourd against the fruit fly. *Indian Farming*, **9**: 8.