J Agric Rural Dev ***6****(1&2), 91-97, June 2008* *ISSN 1810-1860*

SCHOOL OF AGRICULTURE AND RURAL DEVELOPMENT
কৃষি ও পল্লী উন্নয়ন অনুষদ

Available online at
http://www.banglajol.info/index.php/jard

JARD
Journal of Agriculture & Rural Development

Determination of Economic Injury Levels of *Maruca vitrata* in Mungbean

M. A. ZAHID [1*], M. M. ISLAM[2] & M. R. BEGUM[3]

[1]Agriculture Research Station, BARI, Burirhat, Rangpur, Bangladesh
[2]Rangpur Dinajpur Rural Service (RDRS), Rangpur, Bangladesh
[3]Regional Agriculture Research Station, BARI, Ishurdi, Pabna, Bangladesh

ABSTRACT

Maruca vitrata is considered to be one of the major pests of mungbean. The damage potential and economic threshold levels of Maruca vitrata larvae on mungbean were worked out at ARS, BARI, Burirhat, Rangpur during rabi 2005-2006 and 2006-2007. On an average single larva per m row reduced the yield to the extent of 154 kg/ha and 106 kg/ha in 2005-2006 and 2006-2007 cropping seasons, respectively. The ratio of the value of yield saved to the cost of insecticide application at one larva per m row in 2005-2006 was 1.45 and same in 2006-2007 was 1.34. EIL for Maruca vitrata were determined as 1.0 and 1.16 larvae per m row in 2005-2006 & 2006-2007respectively. ET value was determined from EILs and those were found to be at 0.75 and 0.87 larvae per m row in 2005-2006 & 2006-2007 respectively. On the basis of means of two years the EIL and ETL values of Maruca vitrata were 1.08 & 0.81 larvae per m row, respectively.

Key words: ETL, EIL, *Maruca vitrata,* Mungbean.

INTRODUCTION

The knowledge of economic threshold level (ETL) helps to determine whether an insect is to be classified as a pest or not. ETL is the pest density at which control measures should be applied to prevent an increasing pest population reaching the economic injury level (EIL). Control measures are taken at this stage so that this pest does not exceed the economic injury level. The ideas expressed by Pierce (1934) with regard to the assessment of insect damage and the initiation of control measures became one incentive for the development of a concept of economic injury level. In the later years, Stern *et al.* (1959) who formally proposed the concept of economic threshold levels as the number of insect (density or intensity) when management action should be taken to prevent the increasing pest population from reaching economic injury level. According to Stern *et al.* (1959), EIL is the lowest pest population density that will cause economic damage. It is the level at which damage can no longer be tolerated and, therefore, at that point or before reaching that level, it is desirable to initiate deliberate control operation.

Mungbean is an important pulse crop grown in Bangladesh for its high price, easy digestibility, good flavor and high protein content. It occupies about 10% of the total area under pulses and contributes 8.5% of the total pulse production in the country BBS (2004). Mungbean is severely

* Corresponding author: Scientific Officer, ARS, BARI, Burirhat, Rangpur, Bangladesh

damaged by a number of insect pests. Among them pod borer (*Maruca vitrata*) is considered to be major pest.

Maruca vitrata belongs to the family Pyralidae of order Lepidoptera. The caterpillars damage flower buds, flowers and developing pods. They also web inflorescences. The pods are malformed because of webbing. The caterpillars remain in the webbed mass and also feed upon the flowers and developing pods. In India, Kalode and Sharma (1993) and Srinivasan (1994) listed this pest as a pest of cowpea, mungbean, beans, pegionpea and chickpea. In Bangladesh, Rahman (1989), Sardar and Ahmad (1992) and Das (1998) identified and listed this pest of pigeonpea, beans, blackgram and mungbean. The losses in yield caused by the pest in Madhya Pradesh of India were 35 to 40% (Bindra, 1968). In Bangladesh, 20 to 30% pods were found to be damaged by this borer (Rahman, 1989). Keeping this point in mind, the present research work was undertaken to determination the EIL of *M. vitrata.*

MATERIALS AND METHODS

The experiment was conducted at ARS, Burirhat, Rangpur during rabi seasons of 2005-2006 and 2006-2007. The methods of artificial infestation by different levels of larval population were followed to establish the economic injury levels of *M. vitrata*. The EIL was determined based on the benefit cost ratio as suggested by Farrington (1977). There were six treatments consisted of six different larval density *i.e*. 0, 1, 2, 3, 4 and 5 larvae per m row length, released at flowering stage of the crop.

Seeds were sown in row, maintaining row to row distance. The experiment was laid out in Randomized Complete Block Design (RCBD). The plants of one meter row length was covered with nylon mesh cages of 1.0 × 0.5 ×1.0 m size before flowering to avoid natural infestation. The cages were designed in such a way that they did not interrupt ventilation and aeration to the growing plants inside. The bottom edges of the cages were inserted into the soil in all sides to check the escape or entry of larvae. These nylon net cages were erected on bamboo sticks fixed in four corners. The second or third instar larvae were released once at the time of flowering and subsequently at 15 days interval to maintain constant population till the maturation stage of the pod. Pupae and prepupal stages of larvae from the previous release were collected at the time of next release.

The number of total and damaged pods and weight of grains from all the covered plants of each cage were recorded. Relationship between the larval density and the percentage of pod damage was worked out by correlation co-efficient and regression equations. Yield data were converted into kg/ha. Yield losses due to different treatments were derived by deducting the yield of the respective treatment from the yield of control (where no larvae were released). The value of yield loss was determined according to the wholesale market price of mungbean grains prevailing at Rangpur just after harvest during the season. Eighty percent of the yield loss was considered to be avoided with insecticidal treatment, hence was taken as avoidable loss or yield saved. Benefit cost ratio (BCR) was worked out as the ratio of the value of yield saved to the cost of insecticidal application. Cypermethrin @ 0.02% was considered for calculating the cost of insecticidal application. Finally, the economic injury level for pod borer larvae was calculated by fitting regression equation Y = a+bx, between larval population levels and BCR. The larval density corresponding to unit benefit cost ratio was the economic injury level and economic threshold level was set at 75% of EIL (Pedigo, 1991).

RESULTS AND DISCUSSION

Total number of pods per plant ranged from 10.66 to 12.00 during 2005-2006 and 10.33 to 14.00 during 2006-2007, respectively. The differences among the various treatments were found non-significant during 2005-2006 but in 2006-2007 they were significant at 5% levels. Sharma (1985) reported that there was no significant effect on the bearing of pods in chickpea. Similar results were also reported by Reddy *et al.* (2001) in pigeonpea.

A strong positive correlation was found (r = 0.9935) during 2005-2006 and (r = 0.9812) during 2006-2007, respectively between larval density and pod damage percentage (Fig. 1 & 2). The percent pod damage was increased significantly with rise in larval density per plant during two seasons (Table 1 & 2). A density of one larva per plant caused about around 8-11% pod damage

(11.21% during 2005-2006 and 8.23% in 2006-2007). This was in conformity with earlier studies (Anonymous, 1990; Reddy *et al*., 2001) where 5-10% pod damage was reported with single larva of *Helicoverpa armigera.* However, increase in larval population per meter row did not show proportionate increase in pod damage. Sharma (1985), Prabhakar *et al.* (1998) and Reddy *et al.* (2001) also found in-proportionate increase in the damage of chickpea pods with increase in the larval population levels.

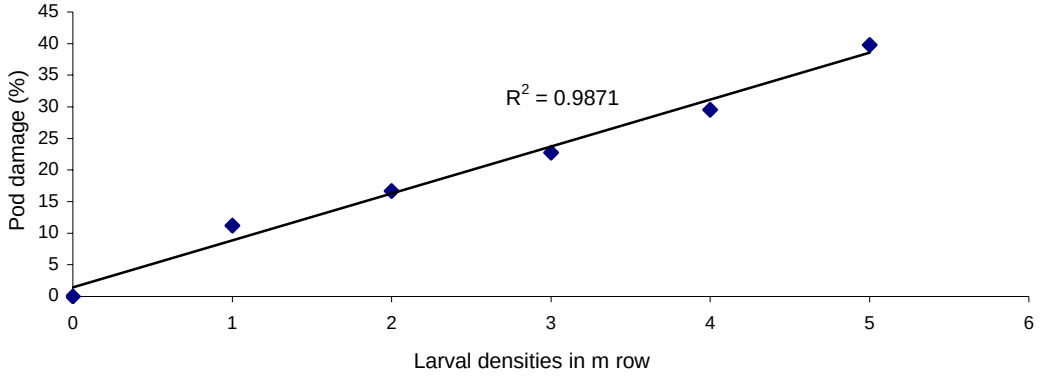

Fig. 1. Relationship between larval densities and pod damage of Maruca vitrata in mungbean during 2005-2006

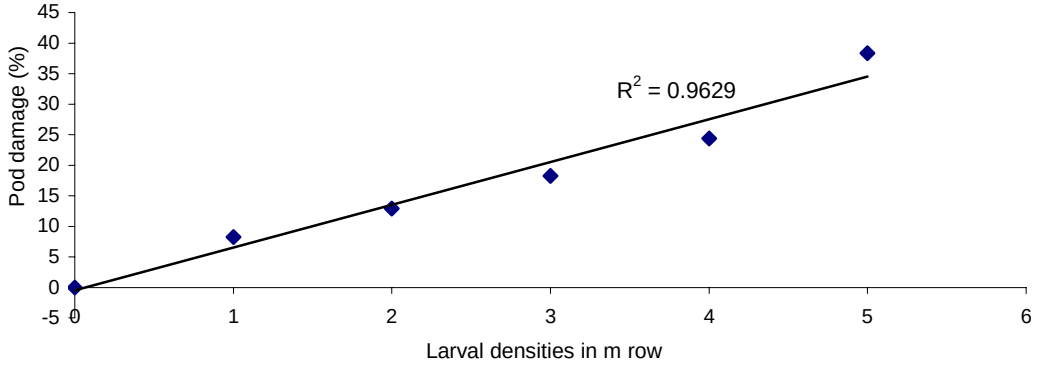

Fig. 2. Relationship between larval densities and pod damage of Maruca vitrata in mungbean during 2006-2007

Table 1. Effect of larval densities of *Maruca vitrata* on pod damage and yield loss of Mungbean at ARS, Burirhat, Rangpur during 2005-2006

No. of larva(e) per m row	Pods/plant	Pod damage (%)	Yield/plant (g)	Yield loss (%)
0	11.33	0.00f	4.28a	0.00f
1	12.00	11.21e	3.71b	13.20e
2	12.00	16.68d	3.49c	18.48d
3	12.00	22.73c	3.21d	24.89c
4	11.33	29.56b	2.88e	32.88b
5	10.66	39.76a	2.35f	45.23a
	NS			

Values are the mean of three replications.
In a column means having same letter(s) are not significantly varied by DMRT at 5% level. NS = Not significant.

The grain yield per plant varied 2.35 g to 4.28 g during 2005-2006 (Table 1) and from 2.91 g to 4.94 g during 2006-2007 (Table 2), corresponding to larval densities of 5 and 0 per meter row length respectively. Loss in grain yield due to presence of one larva per plant was 13.20 and 10.16% during 2005-2006 and 2006-2007 respectively, which amounted 154 kg/ha and 106 kg/ha yield loss per hectare, respectively (Table 3 & 4).

Table 2. Effect of larval densities of *Maruca vitrata* on pod damage and Yield loss of mungbean at ARS, Burirhat, Rangpur during 2006-2007

No of larva(e) per m row	Pods/plant	pod damage (%)	Yield/plant (g)	Yield loss (%)
0	10.33b	0.00f	4.94a	0.00f
1	13.00ab	8.23e	4.37b	10.16e
2	14.00a	12.89d	4.19bc	14.36d
3	13.67a	18.27c	4.03c	18.95c
4	12.33ab	24.35b	3.69dd	25.18b
5	11.00ab	38.33a	2.91e	40.82a

Values are the mean of three replications.
In a column means having same letter(s) are not significantly varied by DMRT at 5% level.

Table 3. Economic analysis of *Maruca vitrata* management of Mungbean at ARS, Burirhat, Rangpur during 2005-2006

No. of larva(e) per m row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk./ha)	Value of yield loss saved	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide	Labours charge	Total cost	
0	1191a	-		-	-	-	-	-
1	1037b	154	3850	3080	1437.50	675	2112.5	1.45
2	987c	204	5100	4080	1437.50	675	2112.5	1.93
3	888d	303	7575	6060	1437.50	675	2112.5	2.86
4	805e	386	9650	7720	1437.50	675	2112.5	3.65
5	683f	508	12700	10160	1437.50	675	2112.5	4.8

Price of mungbean grain 40 Tk./kg. Cypermethrin 1150 Tk./lit.
1.25 lit was used. Labour 120×9.

Table 4. Economic analysis of *Maruca vitrata* management of mungbean at ARS, Burirhat, Rangpur during 2006-2007

No. of larva(e) per m. row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk./ha)	Value of yield loss saved (Tk./ha)	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide (Tk.)	Labors charges (Tk.)	Total cost (Tk.)	
0	1061a	-	-					
1	955b	106	4240	3392	1437.50	1080	2517.50	1.34
2	914c	147	5880	4704	1437.50	1080	2517.50	1.86
3	869d	192	7680	6144	1437.50	1080	2517.50	2.44
4	799e	262	10480	8384	1437.50	1080	2517.50	3.33
5	653f	408	16320	13056	1437.50	1080	2517.50	5.18

Price of mungbean grain 40 Tk./kg. Cypermethrin 1150 Tk./lit.
1.25 lit was used. Labour 120×9.

The ratio of the value of yield saved to the cost of insecticide application at one larva per m row was 1.45 and 1.34 during 2005-06 and 2006-07, respectively. EIL lies at the pest population density where BCR would be 1.1. In order to calculate the exact larval density at which BCR would be 1.1 the correlation of larval density (X) with the BCR (Y) was calculated. There was a strong positive correlation and liner relationship between those two variables (Fig. 3 & 4). The regression equations derived were as follows:

Y = 0.9008 × + 0.1962 during 2005-2006
Y = 0.9271× + 0.0405 during 2006-2007

Where,

X = Larval density per m row
Y = BCR

From the above equations the EILs of *Maruca vitrata* larvae determined as 1.0 larva and 1.16 larva per m row during 2005-2006 and 2006-2007, respectively (Fig. 3 & 4). On the basis of means of two years, the EIL value was 1.08 larva per m row in mungbean. Odak and Thakur (1975) reported that more than four larvae per m^2 in chickpea at flowering stage caused economic injury. Nath and Rai (1995) found EIL of gram pod borer under natural condition to be 1.77 to 2.00 larvae per m row length. Reddy *et al.* (2001) also noticed that EIL of *Helicoverpa* in pigeon pea was 0.78 to 0.80 larvae per plant. However, Prabhakar *et al.* (1998) found EILs of chickpea pod borer were 0.9 and 1.23 larvae per m for unirrigated and irrigated crops, respectively.

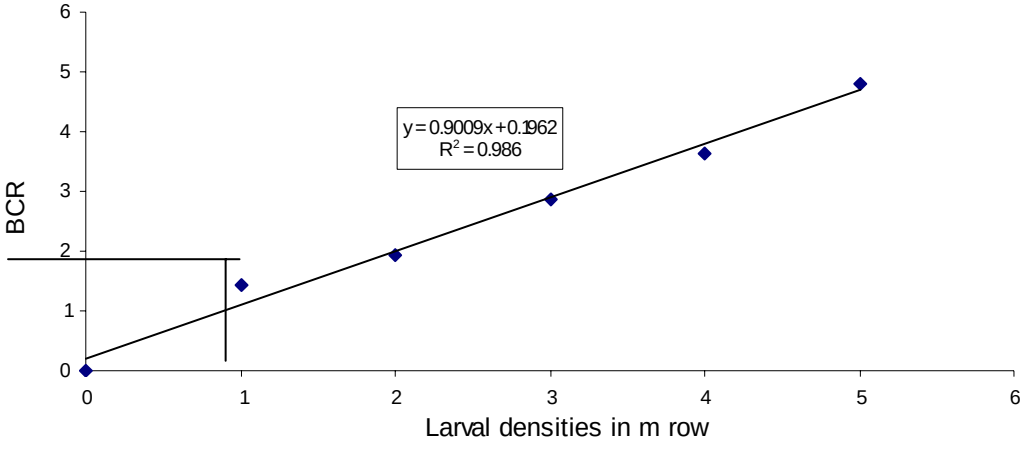

Fig. 3. Relationship between larval densities and BCR in mungbean during 2005-2006

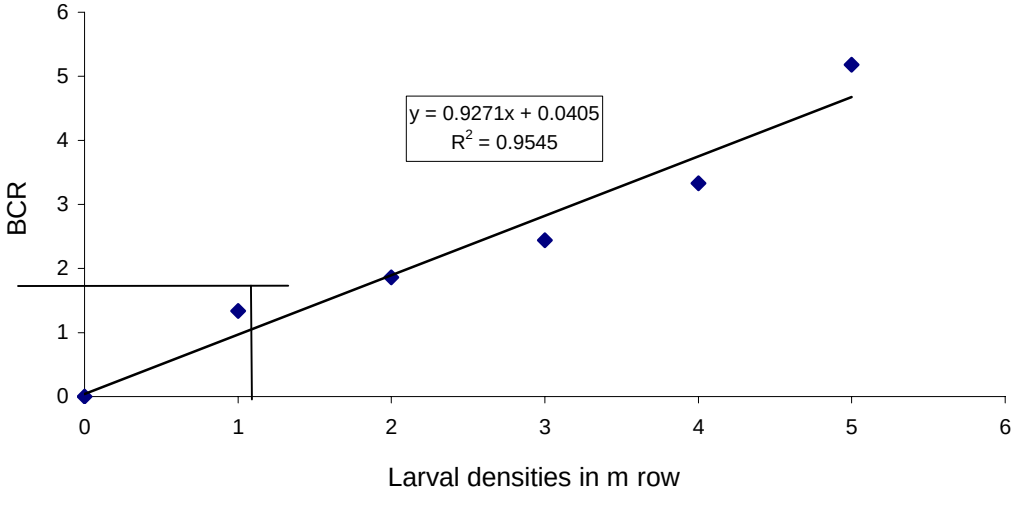

Fig. 4. Relationship between larval densities and BCR in mungbean during 2006-2007

In the present study ET values were determined from EILs and those were found to be at 0.75 and 0.87 larvae per m row during 2005-2006 & 2006- 2007, respectively. Therefore, on the basis of means of two years the ETL value was 0.81 larva per m row in mungbean. Chaudhary and Sharma (1982) calculated ETL values for *H. armigera* of chickpea to be 1.0. Reports by Singh and Reddy (1976) and Whitman *et al.* (1995) are also very close to 1.0 larva per m row.

CONCLUSION

Results of the present study showed that the control measures should be initiated when the *Maruca vitrata* larval population reaches one larva per m row length in mungbean plants in order to prevent the population in reaching economic injury levels.

LITERATURE CITED

Anonymous. 1990. Recommendation of the First National Workshop on *Heliothis* Management: Current Status and Future Strategies. Directorate of Pulse Research, Kanpur. 30-31 pp.

Bangladesh Bureau of Statistics (BBS). 2004. "Statistical Yearbook of Bangladesh". Ministry of Planning, Government of People's Republic of Bangladesh, Dhaka. 141 pp.

Bindra, O. S. 1968. A note on the study of varietal resistance in pulses to different insect pests. *In* "Second Annual Workshop on Pulse Crops". April 1–3, IARI, New Delhi. pp. 25-31.

Chaudhary, J. P. and Sharma, S. K. 1982. Feeding behaviour and larval population levels of *H. armigera* causing economic damage to gram crop. *Haryana Agril Univ J Research* **12**(3), 462-466.

Farringtion, J. 1977. Economic threshold of insect pest population in present agriculture: A question of applicability. *Pest Articles and News Summaries* **23**(2), 143-148.

Kalode, M. B. and Sharma, H. C. 1993. Host-plant resistance to insects: Progress, problems and future needs. *In* "Pest and Pest Management in India– The Changing Scenario" (H. C. Sharma and M. Veerabhadra Rao, Eds.). Plant Protection Association of India, Hyderabad. pp. 229-243.

Nath, P. and Rai, R. 1995. Study of the bio-ecology and economic injury levels of *Helicoverpa armigera* infesting gram crop. *In* "Proceeding of National Seminar on International Pest Management (IPM) in Agriculture", 19-30 December, Nagpur. pp. 20-21.

Odak, S. K. and Thakur, B. S. 1975. Preliminary studies on the economic threshold of gram pod borer *Heliothis armigera* (Hubn) on gram. *In* "All India Workshop on Rabi Pulses". A.P.A.U., Hydrabad, 29th Sept -1st Oct. pp. 29-30.

Pedigo, L. P. 1991. "Entomology and Pest Management". Macmillan Publishing Company, New York. pp. 107-119.

Pierce, W. D. 1934. At what point does insect attack become damage? *Entom News* **45**, 1-4.

Prabhakar, M., Singh, Y. Singh, V. S., and Singh, S. P. 1998. Economic injury levels of *Helicovera armigera* in chickpea as influenced by irrigation. *Indian J Entom* **60**(2), 109-115.

Rahman, M. M. 1998. Pest complex of flower and pods of pegionpea and their control through insecticide application. *Bang J Sci Res* **7**(1), 27-32.

Reddy, C. N., Singh, Y. and Singh, V. S. 2001. Economic Injury level of gram pod borer (*Helicoverpa armigera*) on pegionpea, *Indian J Entom* **63**(4), 381-387.

Sardar, M. M. A. and Ahmad, M. 1992. Genotype-pest relationship on lentil and bean in field and storage. *BAU Res Prog* **6,** 170-175.

Sharma. 1985. Studies on economic threshold and estimation of damage of *Heliothis armigera* on chickpea. Unpublished [PhD Thesis], JNKVV, Jabalpur (M. P.). pp. 90 pp.

Singh, B. R. and Reddy, A. R. 1976. Studies on minimum population level of gram pod borer which caused economic damage to Gangal gram crop. *In* “All India Rabi Pulses Workshop”, ICAR, Varanasi. pp. 30-34.

Srinivasan, K. 1994. Resent trends in insect pest management in vegetable crop. *In* “Trends in Agricultural insect Pest Management” (G. S. Dhaliwal and R. Arora, Eds.), Commonwealth Publishers, New Delhi. pp. 345-372.

Stern, V. M., Smith, R. F., Vanden Bosch, R. and Hagen, K. S. 1959. The integrated control concept. *Hilgarda,* **29**(2), 81-101.

Whitman, J. A., Anders, M. M., Row, V. R. and Mohan Reddy, L. 1995. Management of *Helicoverpa armigera* (Lepidoptera: Noctuidae) on chickpea in South India. Thresholds and economics of host plant resistance and insecticide application. *Crop Protec.* **4**(1), 37-46.