ENTOMON 42(2): 159-164 (2017)
Article No. ent. 42210

Impact of yam bean genotypes on growth and development of spotted pod borer *Maruca vitrata* G. (Lepidoptera: Pyralidae)

S.K. Sathi, P.P. Singh*, A. Narayan and R. Prasad

Tirhut College of Agriculture, Dr Rajendra Prasad Central Agricultural University, Dholi, Muzaffarpur 843121, Bihar, India. Email: ppsinghdholi@rediffmail.com

ABSTRACT: Impact of eight yam bean genotypes *viz;* DHP-2, DPH-11, DPH-17, DL-14, DPH-18, DPH-45, Nepali and R.M-1 on growth and development of *Maruca vitrata* G. under laboratory conditions studies indicated that, R.M-1 favours spotted pod borer in laying eggs with maximum fecundity of female moth (80 eggs per female). Length of all the five instars and larval weight was also found maximum in genotype R.M-1, showing the suitability of this genotype for the growth and development of spotted pod borer. Among the test genotypes, the total life cycle of *M. vitrata* was shorter and faster on R.M-1 showing its preference.

KEYWORDS: Spotted pod borer, *Maruca vitrata*, yam bean, genotypes

INTRODUCTION

Among tuber crops, yam bean (*Pachyrhizus erosus* L.) occupies an important place and is being widely grown in uplands of Bihar, West Bengal, Uttar Pradesh, Odisha and Assam. It is popularly known as Mishrikand, Kesaur in Bihar, Sankalu in West Bengal, Assam and Odisha. It belongs to leguminocea family and commercially propagated by seed. Yam bean crop when grown for seed purpose, its flower buds and pods are reported to be infested by a Lepidopteron pest identified as spotted pod borer, *Maruca vitrata* G., with the extent of pod damage up to 40.0 per cent in Bihar (Singh and Yadav, 2006). Besides yam bean, this pest also occurs on many other economically important grain legumes (Chandrayudu *et al*., 2005).Present study was undertaken to study growth and development of spotted pod borer on different genotypes of yam and its growth index.

MATERIALS AND METHODS

Biology of *M. vitrata* was studied in the laboratory conditions during October to November, 2009-10 and 2010-11 in the Department of Entomology, T.C.A., Dholi. The initial culture of *M. vitrata* was developed in laboratory (Sunitha *et al*., 2008) by collecting two hundred larvae from field on unsprayed yam bean crop. These larvae were utilised for maintaining the mass culture of *M. vitrata*, the larvae were reared on separate clean and sterilized glass jar of 30cm diameter and 10cm height on flowers and pods of yam bean. The open end of jars was covered with muslin cloth for proper aeration and tight with rubber band. As soon as larvae started to pupate these were transferred to another petriplates containing flowers and leaves of yam bean at the bottom. After getting population, one pair of pupae consisting male and female which were sexually differentiated on the basis of

* Author for correspondence

morphological traits (genital pore situated ventrally on 9th abdominal segments in male and 8th abdominal segment in case of female) were kept separately in glass jar for emergence of adults. Each glass jar contains flower shoot, pods and leaves of one genotypes of yam bean and all the genotypes along with pupae were replicated thrice. Similarly 10 pupae were kept in a separate glass jar and covered with muslin cloth for emergence of adult. Eight pair of freshly emerged adult moth were transferred into eight separate glass jar with filter paper at bottom and each jar contained flower, buds, leaves and pods of each genotypes for oviposition. A cotton swab soaked in 0.2 per cent sugar solution was provided in each glass jar for adult feeding. Eggs laid were collected from young leaves, flowers and pods and allowed for hatching. The newly hatched larvae were transferred into fresh container with tender buds, flowers and pods of further larval development. The biological parameters such as pre-oviposition, oviposition, adult longevity, incubation period, larval length (instar wise), larval duration, larval weight, pre-pupal period, pupal period, sex ratio, egg hatchability and adult feeding were recorded. The impact of different genotypes on growth and development of *M. vitrata* was studied in consideration of earlier reports of Chandrayudu *et al*. (2005) by analyzing the data on different biological parameters following Completely Randomize Design and making stage-wise comparison.

RESULTS AND DISCUSSION

Pre-oviposition period: On perusal of pooled mean data of two years, considerably shorter pre-oviposition period (1.44 days) was recorded on R.M-1 while it was maximum (1.82 days) on DPH-2 (Table-1). The pre-oviposition period on the genotypes like- Nepali, DPH-45 and DPH-18 was1.50, 1.61 and 1.71 days, respectively which being higher than that on R.M-1. Remaining genotypes DL-14, DPH-17 and DPH-11 recorded 1.77, 1.79 and 1.80 days, respectively which were statistically at par.

Oviposition: Oviposition period ranged from 3.48 to 3.95 days with minimum and maximum being on DPH-2 and R.M-1, respectively (Table-1). It was shorter on R.M-1 and longer on DPH-2 showing impact of genotypes. No work seems to have been done earlier on these aspects in relation to yam bean genotypes but the reports of some workers who studied the effect of certain host plants on this biological parameter of *M. vitrata* supported the present finding (Chinnabhai *et. al.* 2002; Ghorpade *et. al.* 2006; Bindu and Jhala, 2007).

Number of eggs laid by *M. vitrata* varied considerably depending upon the type of genotypes used on its larval food. Maximum number of eggs (80.00) per female was laid when the genotypes R.M-1 was used as food for the larvae, while it was minimum (65.40) in case of females reared on DPH-2. Significant differences were observed in number of eggs laid per female from the adults reared on genotypes *viz;* DPH-11, DPH-17, DL-14, DPH-18, DPH-45 and Nepali were recorded be 68.30, 69.30, 70.60, 71.70, 72.30 and 74.60, respectively. Among the genotypes, R.M-1 proved most suitable for the reproduction followed by Nepali. Remaining genotypes DPH-45, DPH-18, DL-14, DPH-17 and DPH-11 occupied the position in ascending order and were statistically on par. Eggs were laid in batches of two to seven glued to the surface of flowers and pods. The freshly laid eggs were pale yellow or white in colour later develop in darkish towards the centre of eggs.

Although, there were evidences in literature to show the fecundity of this insect got influenced by the type of host plants used as larval food (Ghorpade *et. al.* 2006; Bhagwat *et. al.* 2006; Bindu and Jhala, 2007 and Sonnune *et. al*; 2010); however, the present findings are first one so far on the effect of yam bean genotypes on oviposition capacity of *M. vitrata* concerned.

Incubation period: The duration of egg period on different genotypes exhibited significant variation ranging from 2.50 to 4.00 days, the shortest and longest being on R.M-1 and DPH-2, respectively (Table-1). In Nepali, DPH-45, DPH-18, DL-14, DPH-17 and DPH-11 it was 2.60, 2.70, 2.90, 3.20, 3.40 and 3.90 days respectively. The incubation period recorded on R.M-1, Nepali, DPH-45, DPH-

18, did not differ from each other statistically whereas, the genotypes DL-14, DPH-17 and DPH-11 were close to DPH-2. Chandrayudu *et al.* (2005), Bindu and Jhala (2007) and Sonnune *et al.*(2010) reported that the incubation period of this pest greatly influenced by types of food plants used for its rearing.

The viability of eggs registered a significant variation and it was found to be lowest and highest on the genotypes DPH-2 (51.83%) and R.M-1 (72.39%). The viability of eggs laid on Nepali (70.25%), DPH-45 (64.06%), DPH-18 (62.22%) and DL-14 (59.91%) proved significantly higher than that on DPH-17 (53.18%) and DPH-11 (52.87%) which did not differ significantly from DPH-2 (51.83%) but proved significantly inferior to R.M-1 (72.39%) (Table 1).

From the above results, it is concluded that R.M-1 and DPH-2 proved most and least favourable genotypes, respectively for egg viability (Hatchability) of *M. vitrata*. Bhagwat *et al.* (2006) who recorded higher hatchability on pigeon pea genotypes ICPL-90036-MI-2 followed by ICPL-90011, while lowest on MFG 537-MI-2-M5. Likewise, Ghorpade *et al*. (2006), Bindu and Jhala (2007) and Sonnune *et al*. (2010) also recorded variation in egg viability of *M. vitrata* when reared on different host plants.All these studies corroborate the present findings.

Larval development: The length first instar larvae white in colour with brownish head ranged 1.40 to 1.80 mm on different yam bean genotypes and it was significantly longer in R.M-1 (1.80 mm), while shotest (1.40 mm) on DPH-2. There were no significant differences among Nepali, DPH-45 and DPH-18 (1.75 mm, 1.74 mm and 1.73 mm respectively). On DL-14, DPH-17 and DPH-11 it was recorded as 1.69mm, 1.56mm, 1.46mm respectively (Table-1).

The second instar larvae were recognized by creamy white in colour with dark patches on the body. Length of second instar larvae ranged from 5.75-6.33 mm on different yam bean genotypes and it was significantly longer on R.M-1 while shortest on DPH-2. In Nepali, DPH-45, DPH-18, DL-14, DPH-17 and DPH-11 a mean value of 6.28, 6.25, 6.20, 6.17, 5.91 and 5.80 mm respectively were recorded.

The third instar larvae were recognized from other instar by the presence of prominent dark patches on the body and creamy white in colour. The length of third instar varied from 7.90mm to 8.46mm. Maximum (8.46 mm) was recorded on R.M-1 and minimum (7.90 mm) on DPH-2. The mean length of larvae recorded on Nepali, DPH-45, DPH-18 and DL-14 was around 8.44, 8.41, 8.40 and 8.37 mm respectively with non-significant difference among them. The remaining genotypes occupied intermediate position.

The length of fourth instar larvae revealed that significantly higher (11.36 mm) when they were reared on the genotype R.M-1, while lowest larval length (10.81 mm) was recorded on DPH-2 which was at par with that on DPH-11 (10.86 mm). No significant differences in it were observed when larvae reared on Nepali and DPH-45 with its mean value of 11.29mm and 11.25 mm, respectively. On the other hand, DPH-18 and DL-14 showed almost similar effect on the length of developing larvae with mean value of 11.24 and 11.20 mm, respectively followed by DPH-17 (11.04 mm) (Table 1).

The fifth instar larvae were brownish in colour with dark brown head and absence of body spots. Significantly longer length (17.39 mm) was recorded when larvae were reared on R.M-1 followed by Nepali (17.33 mm) and lowest in DPH-2 (16.72). There was no significant difference in respect of larval length when larvae were reared on DPH-45 (17.30 mm), DPH-18 (17.29mm) and DL-14 (17.26mm) and remaining two genotypes DPH-17 and DPH-11 occupied sixth (17.11mm) and seventh (16.81mm) position. The present findings got support from the reports of Ghorpade *et al.* (2006), Bindu and Jhala (2007) and Sonnune *et al.* (2010) who studied the impact of various host plants on this pest.

Total larval duration of *M. vitrata* when reared on different yam bean genotypes exhibited significant difference. Shortest larval period 10.80 days was recorded on R.M-1 which was statistically at par

with Nepali (11.00), DPH-45 (11.50) and DPH-18 (11.80). On DL-14, DPH-17, DPH-11 and DPH-2 it was 12.00, 12.30, 12.60 and 13.00 days respectively. Statistically the yam bean genotypes DL-14, DPH-17, DPH-11 and DPH-2 were at par with each other in influencing the rate of larval development of the pest under study. None of the references was found on effect of different yam bean genotypes on larval duration of *M. vitrata*. However, a number of earlier workers reported impact of different host plants other than yam bean on larval duration of *M. vitrata* (Chinnabhai *et al.,* 2002; Chandrayudu *et al*., 2005 and Sonune *et al.,* 2010).

Weight attained by full grown larvae of *M. vitrata* differed significantly among different genotypes of yam bean. Pooled mean data of two years clearly revealed that significantly higher larval weight (75.00 mg) was recorded when the genotype R.M-1 was used as food while the lowest larval weight (56.30 mg) was recorded on DPH-2. Larvae reared on Nepali and DPH-45 weighed 71.90 and 66.20 mg, thus occupying second and third position, respectively. On remaining genotypes DPH-18, DL-14, DPH-17 and DPH-11, the larval weight of *M. vitrata* was recorded to be 63.20, 62.40, 61.40 and 58.10 mg respectively. No work have been reported so far on the effect of yam bean genotypes on larval growth and development of *M. vitrata*. However, evidences are available in literature to show the differential effects of host plants other than yam bean on the larval weight (Bhagwat *et al*., 2006 and Sunitha *et al*., 2008).

The full grown larvae stopped feeding before pupation and spun transparent silken webbing around its body in which it finally transformed into pupa. The pre-pupal stage was greenish in colour. On the basis of mean of two years data presented in Table-1, it revealed that shortest pre-pupal period (1.32 days) was recorded on R.M-1 which was statistically at par to Nepali (1.34 days). The longest pre-pupal period (1.66 days) was recorded on DPH-2 which was at par to DPH-11 (1.64 days). The full grown pupa was radish brown in colour and it was observed that the pupation takes place generally on flowers and sometimes at the bottom of rearing container. The duration of pupa was found considerably influenced by yam bean genotypes on which its larvae were reared. On R.M-1 it was shortest (6.50 days), while longer (7.90 days) on DPH-2. On the remaining genotypes Nepali, DPH-45, DPH-18, DL-14, DPH-17 and DPH-11, the mean pupal periods were 6.70, 6.90, 7.00, 7.10, 7.40 and 7.70 days, respectively. While pupal weight of male and female pupae ranged from 27.86 to 33.34 and 28.67 to 35.50 mg with minimum and maximum being on DPH-2 and R.M-1 respectively. No work seems to have been reported earlier on this aspect with particular reference to yam bean genotypes. However, the present findings got a good support from the reports of earlier workers (Bhagwat *et. al.* 2006; Sonnune *et. al*; 2010) who recorded variation in pupal survival of this insect in response to different host plants used as its larval feeding.

Sex ratio: Females outnumbered males irrespective of genotypes of yam bean. On the basis of means of two years data it revealed that the sex ratios of male to female were worked out to be 1:1.3, 1:1.3, 1:1.3, 1:1.3, 1:1.4, 1:1.4, 1:1.4 and 1:1.5 on DPH-2, DPH-11, DPH-17, DL-14, DPH-18, DPH-45, Nepali and R.M-1 respectively (Table-1).

Longevity: Adult longevity of either sex varied significantly on different genotypes under test used as larval food. Both male and female adults lived for shorter period on DPH-2, while longevity of both the sexes was more on R.M-1. No work seems to have been done earlier on this aspect in relation to yam bean genotypes. However, considerable variations in adult longevity of either sexes of *M. vitrata* on different host plants other than yam bean which served as larval food were recorded by various workers (Ghorpade *et al*., 2006; Bhagwat *et al.,* 2006 and Sunitha *et al*., 2010).

Total life cycle: It was shorter on the yam bean genotype R.M-1(29.36 and 30.86 days in case of male and female respectively). It was recorded as 29.62, 30.36, 30.90, 31.40, 32.08, 32.45 and 33.39 days in case of male; while 31.21, 31.76, 32.40, 32.91, 33.28, 34.05 and 34.69 days in case of female

Table 1. Impact of yam bean genotypes on growth and developement of *Maruca vitrata* G. (pooled mean - 2009-10 & 2010-11)

Parameters	DPH-45	DL-14	DPH-17	R.M-1	DPH-11	Nepali	DPH-18	DPH-2	SEm (+)	CD (P=0.05)
Pre-oviposition (days)	1.61	1.77	1.79	1.44	1.80	1.50	1.71	1.82	0.01	0.03
Ovipostion period (days)	3.87	3.82	3.66	3.95	3.51	3.88	3.84	3.48	0.01	0.04
No. of Egg laid/Female	72.30	70.60	69.30	80.00	68.30	74.60	71.70	65.40	0.39	1.07
Incubation period (days)	2.70	3.20	3.40	2.50	3.90	2.60	2.90	4.00	0.22	0.62
Egg hatchability (%)	64.06	59.91	53.18	72.39	52.87	70.25	62.22	51.83	0.46	12.70
Length of larvae (mm)										
1st instar	1.74	1.69	1.56	1.80	1.46	1.75	1.73	1.40	0.01	0.02
2nd instar	6.25	6.17	5.91	6.33	5.80	6.28	6.20	5.75	0.01	0.02
3rd instar	8.41	8.37	8.23	8.46	8.11	8.44	8.40	7.90	0.01	0.04
4th instar	11.25	11.20	11.04	11.36	10.86	11.29	11.24	10.81	0.01	0.04
5th instar	17.30	17.26	17.11	17.39	16.81	17.33	17.29	16.72	0.01	0.03
Larval period (days)	11.50	12.00	12.30	10.80	12.60	11.00	11.50	13.00	0.39	1.07
Full grown larval weight (mg)	66.20	62.40	61.40	75.00	58.10	71.90	63.20	56.30	0.36	0.99
Pre-pupal period (days)	1.40	1.60	1.62	1.32	1.64	1.34	1.56	1.66	0.01	0.03
Pupal period (days)	6.90	7.10	7.40	6.50	7.70	6.70	7.00	7.90	0.024	0.67
Pupal weight (mg)										
Male pupa (mg)	30.17	28.92	28.29	33.34	28.10	30.79	29.25	27.86	0.57	1.60
Female pupa (mg)	32.14	30.34	29.17	35.50	28.92	34.23	30.95	28.67	0.82	1.31
Adult emergence (%)	76.67	73.33	71.67	81.67	68.33	78.33	76.67	71.67	3.12	9.35
Sex ratio (M/F)	1:1.4	1:1.3	1:1.3	1:1.5	1:1.3	1:1.4	1:1.4	1:1.3	-	-
Adult longevity (days)										
(a) Male	4.00	3.70	3.70	4.30	3.60	4.10	3.80	3.40	0.19	0.52
(b) Female	5.40	5.20	4.90	5.80	4.70	5.70	5.30	4.70	0.21	0.58
Total life cycle-Male	30.36	31.41	32.08	29.36	32.45	29.62	30.90	33.39	-	-
Total life cycle -Female	31.76	32.91	33.28	30.86	34.05	31.21	32.40	34.69	-	-
Growth index	5.24	4.21	3.81	7.17	3.47	6.12	4.28	3.11	-	-

on Nepali, DPH-45, DPH-18, DL-14, DPH-17, DPH-11 and DPH-2, respectively. No work seems to have been reported earlier to ascertain the differential effect in any of the yam bean genotypes on the total life cycle of *M. vitrata*. Bindu and Jhala (2007) reported that the total life cycle of male and female varied from 27.20-30.00 days and 29.36-31.17 days respectively on different host plants. Similar results were obtained by Chandrayudu *et al.* (2005), Ghorpade *et al.(*2006) and Sonnune *et al.* (2010).

Growth index: It was maximum (7.17) on R.M-1 showing its superiority for larval food over all other genotypes. It was closely followed by Nepali and DPH-45 with a growth index value of 6.12 and 5.24, respectively. Lowest growth index value (3.11) was recorded on the genotypes DPH-2 indicating less preferred genotype for the larvae of *M. vitrata*.

The present findings thus amply demonstrate that the R.M-1 and DPH-2 proved to be the most and least preferred food plants respectively for the larvae of *M. vitrata* as reflected by highest and shortest growth index value. No information seems to be available in literature on the relationship between the yam bean genotypes and larval growth of *M. vitrata*. However Ramasubramanian and Babu (1989) and Bindu and Jhala (2007) studies on other host plants support the present findings. On the basis of results for the impact of growth and development of spotted pod borer on different genotypes of yam bean *viz;* DPH-45, DL-14, DPH-17, R.M-1, DPH-11, Nepali, DPH-18, DPH-2, it can be concluded that R.M-1 was found to be most preferred host while DPH-2 to be the least preferred host for growth and development of spotted pod borer, *M. vitrata*.

ACKNOWLEGEMENTS

This research forms part of the approved Ph.D. thesis work of the senior author submitted to the Rajendra Agricultural University and the authors are grateful to the university for the facilities during the studies.

REFERENCES

Bhagwat V.R, Shanower T.G and Ghaffar M.A (2006) Survival, development and fecundity of *Maruca vitrata* (Lepidoptera: Pyralidae) on short duration pigeonpea. Indian J. Pulses Research 19(1): 91-94.

Bindu K. Panickar and Jhala R.C (2007) Impact of different host plants on growth and development of spotted pod borer, *Maruca vitrata* (Fabricius). Legume Research 30(1): 10-16.

Chandrayudu E., Srinivasan S and Venugopal Rao, N. (2005) Comparative biology of spotted pod borer, *Maruca vitrata* (Geyer) in major grain legumes. Journal of Applied Zoological Research 16(2): 147-149.

Chinnabhai Ch., Venkataiah M and Reddy V.M. (2002) Biology of spotted pod borer, *Maruca vitrata*. (Geyer) (Pyralidae:Lepidoptera) on blackgram and greengram. Journal of Applied Zoological Research 13 (2&3): 149-151.

Ghorpade S.A; Bhandari B.D and Salagre A.R. (2006) Studies on biology of legume pod borer (*Maruca vitrata* G.) on pigeonpea in Maharashtra. Journal of Maharashtra Agricultural University 31 (1): 89-91.

Kalita J.B. and Dutta K.S. (1996) Biology of legume pod borer, *Maruca testulalis* (G) on pigenopea. Journal of Applied Zoological Research 7(2): 100-101.

Ramasubramanian G.V. and Sundara Babu P.C. (1989) Ovipositional preference of spotted pod borer, *Maruca testulalis* (Lepidptera: Pyralidae). Legume Research 12(4): 193-195.

Singh P.P and Yadav R.P (2006) Field evaluation of yam bean (*Pachyrrhizus erosus* L.) genotypes against sported pod borer, *Maruca vitrata* G. Infestation in Bihar. In: Root & Tuber Crops in Nutrition, Food security and Sustainable Environment (eds. Naskar *et al.,* 2006), RC of CTCRI, Bhubaneswar. pp. 221-224.

Sonune V.R., Bharodia R.K., Jelhva D.M. and Gaikwad S.E. (2010) Life cycle of spotted pod borer, *Maruca testulalis* (G) on blackgram. Legume Research 33(1): 28-32.

Sunitha V., Lakshmi K.V. and Rao G.V.R. (2008) Laboratory evaluation of certain insecticides against pigeonpea pod borer, *Maruca vitrata* Geyer. Journal of Food Legumes 21 (2): 137-139.

(Received 20 December 2016; revised ms accepted 28 April 2017; published 30 June 2017)