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Survival, development and fecundity of *Maruca vitrata* (Lepidoptera : Pyralidae) on short-duration pigeonpea

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ABSTRACT

Larvae of *Maruca vitrata* (Geyer) were reared on leaves, flowers and pods of nine short-duration pigeonpea genotypes under laboratory conditions to study the suitability of different genotypes for survival, growth, pupation and fecundity of this insect. On an average, 50-94% of the larvae completed their development on flowers and 57-97% on pods. Larval survival and pupation were the greatest on cowpea leaves. The insects reared on pods had higher and shorter larval, and adult developmental periods than on flowers or leaves. The larvae reared on leaves exhibited low larval and pupal weights, longer larval developmental time, higher pupal and shorter adult life span. Larvae reared on pigeonpea cv. ICPL 84023 had the lowest larval and pupal weights and longest pupal and adult developmental time as compared to other cultivars. The adult female whose larvae reared on flowers produced more eggs than those reared on pods. However, egg hatching was greater in the eggs of the moths whose larvae were reared on pods than flowers. Moths emerged from the flower and pod of ICPL 90036-M1-2 produced highest number of eggs followed by ICPL 90011 and MPG 537-M1-2-M5. The influence of different plant parts on *M. vitrata* population dynamics and the potential impact on pigeonpea genotypes has been discussed.

Key words: *Cajanus cajan*, Development, Fecundity, *Maruca vitrata*, Oviposition, Pigeonpea, Survival

Pigeonpea [*Cajanus cajan* (L) Millspaugh] is an important grain legume crop in the semi-arid tropical (SAT) and subtropical areas of the world. It is damaged by over 200 species of insects (5) of which insects damaging the reproductive parts cause the maximum reduction in grain yield (12). *Helicoverpa armigera* Hub., *Melanagromyza obtusa* Malloch., *Maruca vitrata* Geyer, *Exelastis aomosa* W., *Eucosma critica* Meyer., *Mylabris pustulata* Thunb., *Lampedes boeteicus* Linnaeus., and *Clavigralla* spp and other pod sucking bugs are the most important pests of pigeonpea. However, the relative importance of different species varies over locations, seasons, and time of flowering of various cultivars. Short-duration cultivars may suffer greater loss due to insect damage because of shorter growing period and less time available to the plant to compensate from insect damage. Recently, *Maruca vitrata* has emerged as a serious pest because of flowering of the short-duration pigeonpea cultivars during periods of high humidity and moderate temperature in September-October. Since very little is known about the development and survival of *Maruca* on short-duration pigeonpeas, the studies were undertaken. Hyacinth bean has been reported to be the most preferred host for oviposition, followed by cowpea and pigeonpea (9, 11). Okech and Saxena (7) studied the effect of three cowpea cultivars on feeding, utilization of ingested food and development of *Maruca* larvae. Sharma *et al.* (16) reported bionomics of *M. vitrata*, the influence of pigeonpea genotypes on food intake, utilization of ingested food, larval growth and development in the context of insect-plant relationship. The present studies investigated the effect of different plant parts of nine pigenopea and one cowpea cultivars on fecundity, development and survival of *M. vitrata*.

MATERIALS AND METHODS

The insects used in these experiments were obtained from the laboratory culture maintained under disease free conditions at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, India. The culture was initially established from field collected eggs. Larvae were reared on chickpea flour based semi-synthetic diet (8). This insect culture was maintained at 27± °C, with 70% relative humidity, and photoperiod of 12:12 h (LD).

Nine short duration pigeonpea genotypes (MPG 537 (Bulk), MPG 537-M1-2-M5, ICPL 90011, ICPL 84023, ICPL 88034, ICPL 4, MPG 664-M1-2-M20, ICPL 90036-M1-2 0, and ICPL 87) and a local cowpea (Russian giant) were sown (20 June 1997) in the field and used as a food substrates for the larvae.

Ten neonate larvae were placed each on leaves, flowers and pods of ten genotypes and there were 30 replications. Flowers and green pods were kept fresh by placing on a moist filter paper in a petridish. Leaves were plucked with petiole from the upper portions of the plant and the petiole was wrapped with moist cotton to maintain the turgidity of the leaves. Larvae were kept in individual glass vials (3 × 1 cm) and pods were changed on alternate days. Larval weight was recorded seven days after hatching, and pupal weight at 2 days after pupation. Data on post-embryonic development period, their survival and adult longevity were also recorded.

Moths emerging from a particular genotype were released in pairs in plastic cage (30 × 20 × 20 cm), separately and provided with 10% sucrose solution in a cotton swab. The females were provided with the same host, as oviposition substrate on which its larva was reared. The number of eggs laid by a female was recorded and the eggs were tested for hatching percentage.

Data were subjected to analysis of variance (13) and the treatment means were compared with Duncon's multiple range test (3).

RESULTS AND DISCUSSION

The larval survival was highest on pigeonpea pods (89.7%) followed by those reared on flowers (88%), while only 4.7% larvae pupated when fed on leaves (Table 1). No adult emergence was observed when the larvae were fed on pigeonpea leaves and 16.7% adult emergence was recorded on cowpea. The highest larval survival (100%) was recorded on flowers and pods of ICPL 90036-M1-2, which was lowest on flowers and pods of MPG 537-M1-2-M5. *Maruca* larvae fed on pods grew faster and larger, had higher survival, and longer adult life than those on flowers and leaves.

Larval and pupal weight, developmental time and adult longevity were statistically significant when larvae were reared on different plant parts (Table 2). Larval and pupal weights were significantly greater on pods than those on flowers and leaves and pigeonpea leaf fed larvae exhibited the lowest pupal weight (Table 2). Larval and pupal durations were shorter on pods as compared to other plant parts. Genotypes had a significant influence on growth and development of *M. vitrata*. ICPL 84023 fed larvae and larvae reared on ICPL 90036-M1-2 had the longest life as compared to other genotypes, while ICPL 84023 exhibited shorter adult life which was at par with MPG 537, MPG 537-M1-2-M5 and MPG 664-M1-2-M20 (Table 3). The interaction between plant parts and genotypes was significant for larval weight ($F = 19.65$; df 18,530; $P=<0.001$).

Table 2. Growth and development of *M. vitrata* on leaves, flowers, and pods of nine short-duration pigeonpea genotypes under laboratory conditions

Plant part	Larva		Pupa		Adult longevity
	Wt (mg)	Period (d)	Wt (mg)	Period (d)	(d)
Leaves	9.5 c*	14.1 a	31.7 c	8.0 a	18.9 c
Flowers	17.5 b	12.3 b	48.4 b	7.2 b	19.5 b
Pods	33.3 a	11.8 c	54.0 a	7.0 b	22.3 a
Mean	25.0	12.1	51.1	7.2	19.2
± SEM	0.81	0.04	1.29	0.05	0.06
CV%	51.9	5.8	41.4	10.5	4.7

*Values in a column following different letters are statistically significant.

Table 3. Growth and development of *M. vitrata* on nine short duration pigeonpea genotypes under laboratory conditions

Genotype	Larva		Pupa		Adult longevity
	Wt (mg)	Period (d)	Wt (mg)	Period (d)	(d)
MPG 537 (Bulk)	25.3 c*	12.1 c	48.3 ab	6.7 c	18.7 cd
MPG 537-M1-2-M5	19.6 d	12.5 b	48.9 b	6.7 c	18.8 cd
ICPL 90011	18.9 d	12.0 cd	49.4 ab	7.0 bc	19.4 b
ICPL 84023	10.3 e	13.2 a	43.1 b	7.5 a	18.5 d
ICPL 88034	22.6 cd	12.4 bc	50.9 ab	7.0 bc	19.4 b
ICPL 4	24.0 cd	11.7 d	54.4 ab	7.4 a	19.1 b
MPG 664-M1-2-M20	31.7 b	11.6 d	52.2 ab	7.1 b	18.7 cd
ICPL 90036-M1-2	40.6 a	11.6 d	56.9 a	6.9 b	20.6 a
ICPL 87	26.4 c	11.6 d	54.4 ab	7.5 a	19.1 b
Cowpea	29.6 bc	12.2 bc	50.9 ab	7.3 a	19.3 b
Mean	25.0	12.1	51.1	7.2	19.2
± SEM	2.26	0.11	2.78	0.11	0.14
CV%	70.0	7.1	42.3	11.5	5.6

*Values in a column following different letters are statistically significant.

Table 1. Larval and pupal survival of *M. vitrata* on different plant parts of pigeonpea genotypes under laboratory conditions

Genotype	Plant part on which larvae were reared					
	Leaves (n = 300)		Flowers (n = 300)		Pods (n = 300)	
	Larval survival (%)	Adult emergence (%)	Larval survival (%)	Adult emergence (%)	Larval survival (%)	Adult emergence (%)
MPG 537 (Bulk)	0.0	0.0	63.3	56.7	86.7	80.0
MPG 537-M1-2-M5	0.0	0.0	56.6	50.0	70.0	56.7
ICPL 90011	3.3	0.0	86.7	93.0	96.7	83.3
ICPL 84023	0.0	0.0	93.3	76.7	80.0	76.7
ICPL 88034	0.0	0.0	96.7	90.0	96.7	76.7
ICPL 4	0.0	0.0	96.7	90.0	96.7	73.3
MPG 664-M1-2-M20	3.3	0.0	96.7	73.3	90.0	76.7
ICPL 90036-M1-2	16.7	0.0	100.0	93.7	100.0	96.7
ICPL 87	6.7	0.0	96.7	83.3	90.0	83.3
Cowpea	20.0	16.7	93.3	90.0	90.0	76.7
Range	(0-20)	(0-16.7)	(56.6-100)	(50-93)	(70-100)	(56.7-96.7)
Mean	4.7	1.7	88.0	79.7	89.7	78.0

Table 4. Fecundity of *M. vitrata* females whose larvae were reared on flowers and pods of nine short-duration pigeonpea genotypes under laboratory conditions

Genotype	Reared as larvae on flowers		Reared as larvae on pods	
	Eggs female^{-1}	Hatch (%)	Eggs female^{-1}	Hatch (%)
MPG 537 (Bulk)	76.8	41.8 (40.1)*	31.8	55.5 (48.2)*
MPG 537-M1-2-M5	43.4	23.1 (28.1)	22.4	35.2 (32.7)
ICPL 90011	118.4	52.4 (46.4)	132.8	77.9 (62.6)
ICPL 84023	95.2	36.2 (36.1)	42.0	58.4 (50.1)
ICPL 88034	99.6	34.8 (35.8)	52.8	65.0 (55.0)
ICPL 4	51.4	37.6 (36.3)	58.2	53.5 (47.4)
MPG 664-M1-2-M20	81.2	40.9 (39.7)	37.0	60.2 (51.0)
ICPL 90036-M1-2	230.2	60.3 (51.1)	189.0	79.9 (64.5)
ICPL 87	100.6	51.0 (45.4)	116.4	63.2 (52.8)
Cowpea	79.0	42.0 (39.9)	72.2	76.5 (62.4)
Mean	97.6	42.01 (39.9)	75.5	62.5 (52.7)
± SEM	28.32	8.86 (5.79)	27.35	9.12 (6.25)
CV%	64.9	51.7 (34.9)	81.1	32.6 (26.5)

*The figures in parentheses are Arcsin transformed values

larval period (F = 23.44; df = 18,469; P=<0.002), pupal period (F = 9.47; df = 18, 411; P=<0.001), and adult longevity (F = 21.24; df = 18, 411, P = <0.0010). ICPL 90036-M1-2 was better suited to the larvae of *Maruca* for its growth and development as compared to ICPL 84023. Third instar larvae fed on flowers of ICPL 90011 consumed more feed than those reared on ICPL 85007 (15). Insect weights, in general, are while found positively correlated with fecundity as reported by Southwood (17). *Maruca* larvae required relatively longer time to complete life cycle on leaves than on flowers or pods, and this may expose the larvae to various mortality factors for a longer time. The growth and development of *M. vitrata* were better on ICPL 90036-M1-2 than on the other genotypes tested, which seemed to be more susceptible than ICPL 87 (14).

The moths emerged from the flower-fed larvae produced more number of eggs than those reared on pods (Table 4). However, hatching percentage was highest in eggs laid by moths whose larvae were reared on pods than those on flowers. Moths from the larvae fed on flowers and pods of ICPL 90036-M1-2 produced more number of eggs (230.2 and 189) and had higher hatchability (60.3 and 79.6) followed by ICPL 90011. Fecundity was lowest in insects on flowers or pods of MPG 537-M1-2-M5. The moths from flower-reared larvae produced more eggs than those reared on pods. *Maruca* female preferred pigeonpea leaves for oviposition as compared to other substrates (1, 4).

The effect of host plants on growth, development, oviposition, and fecundity of *M. vitrata* has been well documented by many workers (7, 10, 11). The significant variations in growth, development, and survival of *M. vitrata* on different genotypes suggest association of biochemical, anatomical, and plant parts with resistance to *Maruca* (6). Blaney and Simmonds (2) found antifeedant compounds that inhibited larval development and feeding to different pigeonpea leaf extracts by *Helicoverpa armigera* (Hub). However, it is not clear whether these compounds are in flowers or pods. Such research is needed in case of *Maruca* to determine the role of these plant compounds on the growth, development and oviposition.

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