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## Field biology of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch)

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### Abstract

The field biology of pod fly, *Melanagromyza obtusa* Malloch (Diptera: Agromyzidae) was studied during 2015-16 in the Research Farm, Agriculture Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV, Parbhani)), Maharashtra, India (Latitude: 19° 86' 66" N; Longitude: 75° 70' 72" E; and Altitude: +519.62 m MSL) when the maximum and minimum temperature; morning and afternoon relative humidity; and wind velocity ranged from 27.57 to 31.29 °C and 12.14 to 14.57 °C; 62.86 to 90.71 percent and 18.14 to 47.00 per cent; and 2.43 to 3.14 kmph. The incubation period of *M. obtusa* eggs varied from 4.0 to 5.0 days and the average being 4.4 days. The larval period varied from 8.0 to 11.0 days and took 9.5 days on an average to enter into the pupal stage. The pupal period lasted for about 8.0 to 11.0 days with an average of 9.6 days. The longevity of the adult pod fly varied from 6.0 to 11.0 days and the mean longevity was 8.4 days. The life cycle of *M. obtusa* has completed in 31.9 days.

**Keywords:** Biology, field conditions, life stages, pigeonpea pod fly and *Melanagromyza obtusa*

### 1. Introduction

Pigeonpea is grown throughout the tropics but more widely in south and south-east Asia, where it is a preferred source of vegetable protein [1]. More than 250 insect species have been recorded to attack pigeonpea [2]. However, most damaging pests of pigeonpea are pod borers which attack the reproductive parts of the plant. Among the pod borers, pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) is a more serious pest and infest 12 to 100 per cent pods causing losses of 2.4 to 95.0 per cent on seed and 2,50,000 tonnes by weight [3, 4, 5]. *M. obtusa* is widely distributed throughout India inhabits different climatic regions [6]. In India, pigeonpea pods are available in the field from approximately October to April, and infestations increase rapidly over a relatively short period. Fewer eggs are laid in December and January when temperatures are low. Populations increase as temperatures rise. Long-duration pigeonpea crops which mature in March or April can be heavily damaged [7]. Females copulate within 24 hours after emergence and oviposition quickly follows [8]. The female pod fly inserts its eggs inside the pod wall. Females produce up to 80 eggs and lay them individually in developing pigeonpea pods [7]. After hatching, the young larvae initially feed on the seed surface of soft pigeonpea seeds. Later, they mine into the developing seeds and these mines change into deep galleries and the seeds become unfit for human consumption and germination [9]. Before pupating, the full-grown larvae come out of the seeds and eat partial holes into the walls of the pods to enable the emerging flies to escape. The holes do not communicate with the exterior; each hole retains a thin, circular layer of epidermis. The emerging flies will force through the remaining epidermal layer [8]. The literature reviewed so far lead to the conclusion that few workers have made their contribution to the biology of *M. obtusa* and mostly confined to laboratory conditions, but still the studies with respect to biology of pod fly under natural field condition is lacking. Such study has not been conducted in India so far. Therefore, an attempt was made to study various life stages of *M. obtusa* under natural field conditions.

### 2. Material and Methods

An experiment was conducted at Research Farm and Laboratory, Agricultural Entomology Unit, Agriculture Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani), Maharashtra, India during 2015-2016. The studies on biology of *Melanagromyza obtusa* (Malloch) was carried out on pigeonpea Cv. ICP-8863 under open field conditions as per the method suggested by Subharani and Singh [10]. Pigeonpea Cv. BDN-711 seeds were dibbled in a plot size of 5.4 m × 4.8 m with a spacing of 60 cm × 30 cm.

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All recommended cultural and agronomical practices were followed properly to raise a good crop. None of the insecticide was applied to protect the crop from *M. obtusa* infestation. For studying the biology of pod fly, five flowering twigs of pigeonpea plants were selected randomly and covered with muslin cages to protect the pods from pod fly egg laying. Pod fly pupae were collected from the adjacent pigeonpea field and after emergence males and females were sorted out by examining the genitalia. Thereafter, five pairs of adult flies (male and female) were released in each cage during pod development stage (30-35 days after flowering). After releasing of *M. obtusa* males and females, oviposition was ascertained after 12, 24, 36, 48, 60, 72 and 84 hrs by dissecting the pods in muslin cages (under open field conditions). Number of eggs that were freshly laid and that had freshly hatched on each dissected pod was counted. Observations were made at every 12 hrs intervals to record the incubation period of the eggs on dissected pods only in

muslin cages. For studying the total larval period observations were taken at every 12 hrs interval up to formation of pupae and after pupal formation, pupae were observed at every 12 hrs interval after a week of pupal formation. The pupae were allowed for adult emergence. After emergence of adults from the pupae, male and female were separated by examining the genitalia to make the observations on sex ratio and also adult longevity was recorded.

### 3. Results and Discussion

The data on duration of various life stages of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) under natural field conditions during January, 2016 when the maximum and minimum temperature; morning and afternoon relative humidity; and a wind velocity ranges from 27.57 to 31.29 °C and 12.14 to 14.57 °C; 62.86 to 90.71 per cent and 18.14 to 47.00 per cent; and 2.43 to 3.14 kmph is presented in Table 1.

**Table 1:** Duration of various life stages (in days) of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch)

S. No.	Incubation Period or Egg Period	Maggot Period	Pupal Period	Adult Longevity	Total Life Span	Sex Ratio (Male : Female)
01	05	10	09	08	32	Male
02	05	11	10	11	37	Male
03	04	09	08	07	28	Female
04	05	10	11	09	35	Female
05	05	08	09	10	32	Female
06	04	11	10	08	33	Female
07	04	09	10	08	31	Male
08	04	10	11	06	31	Female
09	04	09	09	07	29	Male
10	04	08	09	10	31	Female
Mean	4.4	9.5	9.6	8.4	31.9	1:1.20

**3.1 Egg:** Females lay single eggs per locule furthest from the developing seed and may be less likely to be crushed. Freshly laid eggs were reflecting white in colour, with smooth tapering posteriorly as well as broad base and projecting into the pod cavity; the tapered end was filled with a transpicuous fluid. Eggs were laid singly, often in partially matured pods rather than in very young or fully matured pods. The incubation period varied from 4.0 to 5.0 days, the average being 4.4 days. The results related to incubation period are in accordance with earlier workers like, Ahmad <sup>[6]</sup> who reported that the egg stage requires 3.0 to 9.0 days which depend upon weather conditions. More than one egg is generally found in a single pod, the maximum being seven, the average four. With the temperature fluctuating between 23 °C and 28 °C, the average incubation period of eggs is 3.1 days <sup>[8]</sup>. While, Ipe <sup>[11]</sup> observed the average incubation period of the eggs to be 2.35 days. Whereas, Singh and Rai <sup>[12]</sup> stated that the incubation period lasted for about 3 and 2.95 days, respectively, which is about the same as observed in the present findings. Similarly, <sup>[10, 13]</sup> reported that the incubation period varied from 2.5 to 3.5 days, the average being  $2.99 \pm 0.16$  days. However, Upadhyay *et al.* <sup>[2]</sup> reported a longer range for the egg stage (3.0 to 10.0 days). Females produce up to 80 eggs and lay them individually into developing pigeonpea pods. Under field conditions, the egg stage lasts for 3 to 5 days <sup>[7]</sup>, which is about the same as observed in the present findings.

**3.2 Maggot (Larva):** The freshly hatched maggots were translucent, reflecting white in colour and later turned to creamy white. The body was divided into segments, which had very tenuous segmental boundaries. For the first few

hours following hatching, the maggot did not bore into the seed but rather fed on the surface and then feed under the epidermis of the seeds. Later instar maggot drills deep into the seed consuming the starchy food as well as the embryo leads to form deep tunneled galleries. The full grown maggot was cylindrical in shape and creamy white in colour which later changed to yellowish before pupation. The maggot period varied from 8.0 to 11.0 days and the average total maggot period of *M. obtusa* was about 9.5 days. The results of the present investigation on duration of maggot period are in agreement with that of Ahmad <sup>[6]</sup> who reported that total maggot development period requires 6.0 to 11.0 days. The results are in accordance with <sup>[11, 12, 14, 15]</sup>, who reported that the development of maggots lasts for 19.1, 18.4, 6.1 and 5.0 days at fluctuating temperatures of 17-21 °C, 17-22 °C, 23-28 °C and 29-34 °C, respectively. Besides, at constant temperatures of 27 °C and 29 °C, it requires 9.8 and 5.0 days, respectively. At Pusa, India, the average duration of larval feeding was 6.1 days in March to April and 18 to 20 days in December <sup>[8]</sup>. The average larval period ranges from 5 to 6 days. The first instar takes about one and a half days, the second instar takes just over two days, and the last instar takes about two and a half days <sup>[16]</sup>. Under field conditions, the three larval stages last for 6 to 11 days <sup>[7]</sup>. Similarly, Subharani and Singh <sup>[10, 13]</sup> reported that there were three larval instars which took  $7.75 \pm 0.53$  days to enter into the pupal stage.

**3.3 Pre-pupa and pupa:** The mature maggots after passing through the pre-pupal stage of about 0.5 to 1.0 days, transformed into a pupa inside the last instar integument in the pod. Freshly formed pupae were yellowish brown in colour

but later turned into dark brown or brownish black. The pupae were cylindrical and broadly rounded at the two ends. The pupal period lasted for 8.0 to 11.0 days with an average of 9.6 days. Similar observations were made by Singh and Ipe<sup>[16]</sup> who reported that the pupation occurs within the pod itself and pupal periods range from 7 to 12 days, depending on the climatic conditions. Similarly, Subharani and Singh<sup>[10, 13]</sup> reported that the pupal period lasted for 9 to 13 days with an average of  $11.38 \pm 0.74$  days. The findings of the present investigation in respect of pupal period are in accordance with<sup>[6]</sup> who reported that the total pupal development period requires 9.0 to 23.0 days. Similarly, Senapati *et al.*<sup>[17]</sup> reported that pupal period of 4.0 to 13.0 days. Interestingly there are wide variations in pupal period as reported by different researchers. The response of pupal stage of *M. obtusa* to various environmental conditions is different from that of the egg and maggot stages in certain respects. The pupae are more resistant to desiccation and can therefore stand reasonable exposures to partially saturated atmosphere. Again the pupal stage is comparatively long or in other words, the rate of pupal development is slower than that of the egg or the maggot stage. However,<sup>[2, 18]</sup> reported that the pupal period of *M. obtusa* ranged from 8.0 to 31.0 days. Under field conditions, the pupal stage lasts for 9 to 23 days<sup>[7]</sup>.

**3.4 Adult:** The adult fly was a small, shining and metallic blue in colour. Emergence from the pupal stage took place in the morning hours. The antennae were aristate, black palpi and the proboscis was brown at apex. In many adults, the abdomen was glossy black with a metallic surface while in some adults the abdomen had a violet colour or a greenish blue colour. Adult longevity ranged from 6.0 to 11.0 days with an average of 8.4 days. The male and female sex ratio was worked out on the basis of sex of adult emerged, classified based on genitalia and studies revealed that the male: female sex ratio was 1:1.20. The results in relation to adult longevity are in accordance with;<sup>[2]</sup> who reported that the life span of the adult ranges from 3.0 to 5.0 days. When fed with honey, the adult stage lasts for approximately 12 days; without feeding, only half as long<sup>[7]</sup>. Subharani and Singh<sup>[10]</sup> reported that the adult longevity on an average lasted for  $5.72 \pm 0.28$  days. Subharani and Singh<sup>[13]</sup> reported the mean longevity of the adult was  $6.59 \pm 0.38$  days. Ipe<sup>[11]</sup> observed under laboratory conditions the adult sex ratio that indicated 49.85 males for every 50.15 females.

**3.5 Total life span:** The total life span of *M. obtusa* (Malloch) varied from 28.0 to 37.0 days with an average of 31.9 days. The findings in relation to the total life span are in accordance with; Subharani and Singh<sup>[10, 13]</sup> reported the life cycle of *M. obtusa* was completed in  $41.74 \pm 0.81$  days.

#### 4. Conclusion

From the present study, it may be concluded that the incubation period of *M. obtusa* eggs, larval period, pre-pupa and pupal period, adult longevity and total life cycle under natural field conditions was 4.4, 9.25, 9.6, 8.4 and 31.9 days when the maximum and minimum temperature; morning and afternoon relative humidity; and wind velocity ranges from 27.57 to 31.29 °C and 12.14 to 14.57 °C; 62.86 to 90.71 per cent and 18.14 to 47.00 per cent; and 2.43 to 3.14 kmph, respectively. The change in weather conditions greatly influences on duration of various stages of *M. obtusa*.

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