

Pupal Parasitization of Pigeonpea Pod Fly, *Melanagromyza obtusa* (Malloch)

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Abstract An experiment was conducted during *kharif*, 2014-15 to study the natural parasitization of *Melanagromyza obtusa* (Malloch) pupae. Three hymenopteran parasitoids viz., *Ormyrus* sp., *Eurytoma* sp. and *Epitranus* sp. parasitized pod fly pupae ranged from 3.23 to 35.14, 2.44 to 14.89 and 2.13 to 4.88% with a mean of 14.06, 3.34 and 0.47%, respectively. Total natural parasitization of pod fly pupae was observed on 51st standard meteorological week which increased gradually and attained a peak on 3rd standard meteorological week with 48.78%. During the season, *Ormyrus* sp. acted as key mortality factor for natural parasitization of *M. obtusa* pupae with greater extent

of parasitization (35.14%); followed by *Eurytoma* sp. The analysis of data revealed strong positive correlation between total number of pod fly pupae with total number of parasitized pupae and total per cent pupal parasitization; and total number of parasitized pupae with total per cent pupal parasitization, respectively; indicating that parasitoids played vital role in pod fly management through its parasitization. Analysis between natural parasitization with weather parameters indicated moderate negative correlation.

Keywords *Melanagromyza obtusa*, Natural parasitization, Pigeonpea, Pod fly, Pupae.

Introduction

Pigeonpea is grown throughout the tropics but most widely in south and south-east Asia, where it is a major source of vegetable protein. More than 150 species are reported to cause injurious to different part of the pigeonpea plant. Among the borers, the pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae), commonly known as tur pod fly or red-gram pod fly is a most noxious and major pest of pigeonpea, *Cajanus cajan* causing maximum damage [1, 2]. About 70 to 80% loss was recorded due to pod fly [2] and losses have been estimated at US \$ 256 million annually [3]. Though concealed behavior of pod fly renders ineffective control by insecticides; till date, chemicals are the only available efficient strategy against *M. obtusa*. Even after two or three insecticidal applications, the crop still undergoes consid-

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erable losses. Also, the insecticides are mostly unsafe to natural enemies and cause hazards to mankind. The use of natural enemies of the pod fly as biological control agents for its management is a promising and viable strategy [4]. So far, more than ten hymenopteran parasitoids viz., *Eupelmus urozonus*, *Ormyrus orientalis*, *Eupelmus* sp., *Microdontomerus* (= *Antistrophoplex*) sp., *Eurytoma* sp., *E. robusta*, *Plutarchia indefensa*, *Pseudotorymus* (= *Senegallia*) sp., *Ormyrus fredreki*, *Plutarchia* sp., *E. melanagromyzae* and *E. ranjithi*; and the incidence of natural parasitization have been reported on *M. obtusa* pupae by various workers. Till now, *O. orientalis* (Ormyridae), pupal endo-parasitoid reported as major biocontrol agent of *M. obtusa* pupae causing 46.66% parasitism [5, 6]. Therefore, the present investigations were carried out at Agricultural Research Station, Badnapur (Dist. Jalna) of Maharashtra state during *kharif*, 2014-2015 to know the impact of parasitoids on *M. obtusa* pupae to promote bio-control of this pest.

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Materials and Methods

An experiment was conducted at Research Farm and Laboratory, Agricultural Entomology Unit, Agricultural Research Station, Badnapur (VNMKV, Parbhani), Maharashtra, India to study the level of natural parasitization of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch). The pigeonpea genotype, ICP-8863 was raised in a plot size of 9.0 m × 9.0 m with standard agronomical practices during *kharif* season of 2014-15 under natural field conditions with row to row and plant to plant distance of 60 cm and 30 cm, respectively. No insecticide was applied to protect the crop from natural infestation of pod fly. The population of pod fly, *M. obtusa* pupae was recorded from pod initiation till harvest of the crop through destructive sampling method. The pupal population was recorded on randomly collected 100 pods covering all the plants of net plot area at weekly intervals based on standard

meteorological weeks (SMW) [7]. The collected pupae were maintained separately at the rate of one per vial and reared at ambient temperature for observing the emergence of different parasitoids. The emerged parasitoids were later identified based on taxonomic features. The per cent parasitization was calculated by using following formula [8, 9].

$$\text{Per cent parasitization} = \frac{\text{Number of parasitized pupae}}{\text{Total number of pupae}} \times 100$$

Correlation was worked out in between natural parasitization with weather parameters. Thus, the generated data was processed properly for interpretation of results.

Results and Discussion

The data on pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) pupal population and its natural parasitization due to different parasitoids from 48th to 10th standard meteorological week (SMW) has been presented in Table 1. The observations revealed that pupal population of *M. obtusa* was prevailing from 48th SMW (4 pupae per 100 pods) which increased gradually and attained a peak on 4th SMW with 47 pupae per 100 pods, respectively. The pupal population declined later to 9 pupae in 10th SMW. The mean population of pod fly pupae was recorded as 23.73 pupae per 100 pods over a period of 15 meteorological weeks during 48th to 10th SMW.

The present studies revealed presence of three hymenopteran parasitoids on pod fly, *M. obtusa* pupae i.e. *Ormyrus* sp. (Hymenoptera: Chalcidoidea: Ormyridae), *Eurytoma* sp. (Hymenoptera: Chalcidoidea: Eurytomidae) and *Epitranus* sp. (Hymenoptera: Chalcidoidea: Chalcidae), respectively; and all the three species are endo-parasitoids of host, *M. obtusa* pupae. The number of parasitized pupae of pod fly varied from one species to another. The incidence of pupal parasitoids viz., *Ormyrus* sp., *Eurytoma* sp. and *Epitranus* sp. was observed on 51st, 52nd and 3rd SMW, respectively; and the number of pod fly pupae parasitized due to *Ormyrus* sp.,

Table 1. Pupal population of pigeonpea pod fly, *M. obtusa* and its natural parasitization.

SMW	Pod fly pupae (No. per 100 pods)	Parasitized pupae (No. per 100 pods)			Total	Parasitization (per cent)			Total
		<i>Ormyrus</i> sp.	<i>Eurytoma</i> sp.	<i>Epitranus</i> sp.		<i>Ormyrus</i> sp.	<i>Eurytoma</i> sp.	<i>Epitranus</i> sp.	
48	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
49	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	31.00	1.00	0.00	0.00	1.00	3.25	0.00	0.00	3.23
52	20.00	7.00	1.00	0.00	8.00	35.00	5.00	0.00	40.00
1	41.00	12.00	1.00	0.00	13.00	29.27	2.44	0.00	31.71
2	37.00	13.00	3.00	0.00	16.00	35.14	8.11	0.00	43.24
3	41.00	14.00	4.00	2.00	20.00	34.15	9.76	4.88	48.78
4	47.00	9.00	7.00	1.00	17.00	19.15	14.89	2.13	36.17
5	41.00	7.00	3.00	0.00	10.00	17.07	7.32	0.00	24.39
6	38.00	5.00	1.00	0.00	6.00	13.16	2.63	0.00	15.79
7	22.00	3.00	0.00	0.00	3.00	13.64	0.00	0.00	13.64
8	9.00	1.00	0.00	0.00	1.00	11.11	0.00	0.00	11.11
9	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mean	23.73	4.80	1.33	0.20	6.33	14.06	3.34	0.47	17.87
Total no. of pod fly pupae × Total no. of parasitized pupae									$r=0.8477$
Total no. of parasitized pupae × Total per cent parasitization									$r=0.9444$
Total no. of pod fly pupae × Total per cent parasitization									$r=0.7623$

Eurytoma sp. and *Epitranus* sp. ranged from 1.00 to 14.00, 1.00 to 7.00 and 1.00 to 2.00 parasitized pupae per 100 pods with a mean of 4.80, 1.33 and 0.20 parasitized pupae per 100 pods, respectively. The parasitized pupae due to *Ormyrus* sp., *Eurytoma* sp. and *Epitranus* sp. were at peak to 14.00, 7.00 and 2.00 pupae per 100 pods on 3rd SMW and bottom-out activity of *Ormyrus* sp., *Eurytoma* sp. and *Epitranus* sp. was observed on 8th, 6th and 4th SMW with 1.00 parasitized pupae per 100 pods. The total parasitized pupae of *M. obtusa* were varied from 1.00 to 20.00 pupae per 100 pods and the mean of pod fly pupae infected by its biocontrol agents during the season (48th to 10th SMW) was recorded as 6.33 per 100 pods over a period of 15 standard meteorological weeks.

There hymenopteran species i.e. *Ormyrus* sp., *Eurytoma* sp. and *Eupelmus* sp. reported from parasitized pod fly pupae, respectively [10]. *Ormyrus* sp. (Hymenoptera: Ormyridae) was reared from *M. obtusa* on *C. latisepalus* pods [11]. Pigeonpea growing areas of in Agra and its nearby districts showed the presence of two pupal parasitoids viz., *Ormyrus orientalis* (Ormyridae) and *Eurytoma* sp. (Eurytomidae) during the surveys carried out in October,

November and December, respectively [12].

Natural parasitization of pod fly pupae due to *Ormyrus* sp. ranged from 3.23 (51st SMW) to 35.14% (02nd SMW) with a mean parasitization of 14.06% over a period of 15 standard meteorological weeks. *Eurytoma* sp. was active from 52nd to 6th SMW and its parasitization was from 2.44 to 14.89% with its maximum and minimum level on 4th SMW (14.89%) and 1st SMW (2.44%), respectively; with a mean parasitization of 3.34% during main crop period (48th to 10th SMW). Natural parasitization of pod fly pupae due to *Epitranus* sp. ranged from 2.13 (3rd SMW) to 4.88% (4th SMW) with a mean of 0.47% over a period of 15 meteorological weeks i.e. 48th to 10th SMW. The generated data also indicated that the natural parasitization of *M. obtusa* pupae was more with the activity of *Ormyrus* sp. (14.06%) than the *Eurytoma* sp. (3.34%) and *Epitranus* sp. (0.47%), respectively. The total natural parasitization of *M. obtusa* pupae was observed from 51st SMW (3.23%) which increased gradually and attained a peak on 3rd SMW with 48.78%. Then, it declined further to 11.11% on 8th SMW and no suppression was observed on 9th and 10th SMW leading to mean parasitization of 23.67% during the

Table 2. Correlation between pod fly pupal population, parasitized pupae due to different parasitoids and parasitization with weather parameters. *Moderate negative correlation.

		Rainfall	Maximum temperature	Minimum temperature	AM humidity	PM humidity	Wind velocity	Evaporation
Pod fly pupae (No.)		-0.3305	-0.4387*	-0.1724	-0.1675	0.0490	0.1737	-0.3216
Number of parasitized pupae	<i>Ormyrus</i> sp.	-0.2389	-0.5263*	-0.2541	0.0185	0.1266	-0.0602	-0.4583*
	<i>Eurytoma</i> sp.	-0.2672	-0.2078	-0.0738	-0.1096	-0.0861	0.0838	-0.1960
	<i>Epitranus</i> sp.	-0.1707	-0.1684	-0.0606	-0.1165	-0.0157	0.1392	-0.0968
	Total	-0.2626	-0.4533*	-0.2097	-0.0271	0.0657	-0.0087	-0.3952
Per cent parasitization	<i>Ormyrus</i> sp.	-0.3010	-0.4572*	-0.3349	-0.1234	-0.0169	-0.1090	-0.3793
	<i>Eurytoma</i> sp.	-0.2960	-0.2706	-0.1602	-0.1459	-0.1101	0.0639	-0.2376
	<i>Epitranus</i> sp.	-0.1670	-0.1755	-0.0725	-0.1210	-0.0115	0.1365	-0.0944
	Total	-0.3202	-0.4339*	-0.3039	-0.1416	-0.0425	-0.0569	-0.3596

season (48th to 10th SMW).

A high level of pupal parasitism of pod fly (87.5%) was observed and also found that the *Ormyrus* sp. was predominant parasitoid throughout the year causing 64.1% to 100% parasitization on pod fly immature stages, whereas, *Eurytoma* and *Eupelmus* were less prevalent and the parasitism by *Eurytoma* sp. was up to 15.4% and for *Eupelmus* sp. it was up to 20.5%, respectively [13]. *Eurytoma* sp. parasitized pod fly pupae to the extent from 3.69 to 5.00% [14]. *O. orientalis* exhibited maximum 37.16% and 10.52% parasitism in November and December, respectively. *Eurytoma* sp. and *Sanegalella* sp. played minor role and their parasitism ranged from 0.72 to 4.50% and 1.53 to 3.60%, respectively [15].

Simple correlation was worked out between total number of pod fly pupae with total number of parasitized pupae and total per cent pupal parasitization, total number of parasitized pupae with total per cent pupal parasitization, respectively. The analysis of data indicated strong positive correlation between total number of pod fly pupae and total number of parasitized pupae with having its regression coefficient 0.8477, indicating that pupal parasitoids of pod fly requires pod fly pupal stage for its biological activity. There was a strong positive correlation between total number of pod fly pupae and total per cent pupal parasitization having its regression coefficient 0.7623, indicating that parasitoids played vital role in parasitization of pod fly pupae through its parasitization. Similarly, total number of parasitized pupae and total

per cent pupal parasitization exhibited a significant strong positive correlation ($r=0.9444$), indicating that the pupal parasitoids could successfully suppress the pod fly pupae.

The analysis of simple correlation between pod fly pupal population, number of parasitized pupae due to different parasitoids and its per cent parasitization with weather parameters is presented in Table 2. The analysis of data indicated moderate negative correlation between pupal population of *M. obtusa* with maximum temperature ($r=-0.4387$) indicating that with increase in temperature, pod fly pupal population gets decrease. Similarly, number of parasitized pupae due to *Ormyrus* sp. with maximum temperature ($r=-0.5263$) and evaporation ($r=-0.4583$); total parasitized larvae, per cent parasitization due to *Ormyrus* sp. and total per cent parasitization due to different parasitoids with maximum temperature were observed to have moderate negative correlation ($r=-0.4533$, -0.4572 and -0.4339), respectively, indicating that increase in temperature decreases parasitization.

Present study revealed that three hymenopteran parasitoids viz., *Ormyrus* sp., *Eurytoma* sp. and *Epitranus* sp. parasitized the pupae of *M. obtusa*. Among these three parasitoids, *Euderus* sp. acted as key mortality factor under natural field condition with greater parasitization of the pest, which ranged from 3.23 to 35.14%. So, it can be concluded that the use of natural enemies of the pod fly, as biological control agents can be a promising and viable strategy for its management.

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