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# Appraisal of economic threshold level for the management of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch)

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**Abstract**
Now-a-days economic damage levels caused by insects and their impacts on crop production are the most discussed parameters in the insect management. The economic threshold level is the basic concept for decision making in integrated pest management programs. Integrated pest management programs are basically different in handling insect problems by focusing on tolerating insect influences than control approaches. Economic threshold level enumerates which levels of insect populations can be tolerated and which cannot; hereby it plays vital role in integrated pest management programs. The economic thresholds would reduce unnecessary use of management tactics in general and insecticides in particular. A study was conducted at Research Farm, Agricultural Entomology Unit, Agricultural Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani), Maharashtra, India during *Kharif* season of 2015-16 to determine the economic threshold level (ETL) for the management of pigeonpea pod fly, *Melanagromyza obtusa* (Malloch). The ETL was found varied among genotypes under study *i.e.* BSMR-736, BDN-708, BDN-2010-1 and ICP-8863 which ranged from 6.44 to 13.06 maggots, 2.64 to 8.38 percent pod damage and 1.09 to 3.56 percent grain damage, with a mean of 7.76 maggots, 4.60 percent pod damage and 2.05 percent grain damage, respectively at which the control measures can be initiated for management of pigeonpea pod fly, *M. obtusa*.

**Keywords:** Economic Threshold Level (ETL), Grain Damage, Maggot Population, Pigeonpea, Pod Damage, Pod Fly and *Melanagromyza obtusa*

## 1. Introduction
Pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae), commonly known as pigeonpea pod fly or red-gram pod fly or tur-pod fly is a major pest; attacking pigeonpea and act as a key pest causing heavy crop losses in India. The total loss in terms of production and monetary value is estimated to be around 250 to 300 thousand tones and 3750 to 4500 million rupees per year, respectively [1]. More than 300 species of insect species have been reported infesting pigeonpea crop [2] of which pod fly, *Melanagromyza obtusa* (Malloch) is of regular occurrence, causing 10-80% damage [3, 4] and estimated to cause a loss of US$ 256 million annually [5]. Losses due to pod fly damage have estimated at Rs. 16,384 million [6]. Numerous attempts have been made to quantify yield losses due to insects [7]; and other efforts to minimize insect injury and damage by using all insect management tools which are available in integrated pest management (IPM) programs [8, 9]. Much controversy now surrounds the whole subject of insecticide use [10]. In spite of the recent emphasis on the development of alternative methods of insect control, the use of bio-control agents to suppress the insect pests [11, 12], the properly timed use of the right insecticide will, for the foreseeable future, continue to play an integral part in pest management programs [13], and keep the environment clean [14]. The farmers apply insecticides to control pigeonpea pod fly. However, most of the pigeonpea growers use scheduled insecticide applications irrespective of insect pest attack. This injudicious use of chemicals has been held responsible for many side effects including economic loss and environmental concerns. There was a dire need to determine the economic threshold level (ETL) for rational use of insecticide application [15]. The literature reviewed so far lead to the conclusion that a few workers have made their contribution on ETL of pod fly, *M. obtusa* (Malloch), but so far the studies with respect to standard ETL of pod fly is lacking. Keeping in view, an attempt was therefore made to determine the ETL for management of pigeonpea pod fly, *M. obtusa*.

## 2. Materials and Methods

An experiment was conducted at Research Farm, Agricultural Entomology Unit, Agricultural Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani), Maharashtra, India during *Kharif* season of 2015-16 as per the method suggested by Patange [16]. A total of four pigeonpea genotypes *viz*., BSMR-736, BDN-708, BDN-2010-1 and ICP-8863 were sown to study the economic threshold level (ETL) of *Melanagromyza obtusa* (Malloch), respectively. Each genotype was sown in a plot size of 5.4 m × 4.8 m with 60 cm × 30 cm spacing between rows and plants, respectively. The studies were carried out in rainfed and pesticide free conditions. Only a protective irrigation was provided during the flowering stage of the crop. A total of six plants of each genotype were covered with separate fine mosquito nets to avoid *M. obtusa* infestation. About five plants of each genotype were allowed for infestation through releasing known population of *M. obtusa i.e.* 10, 20, 30, 40 and 50 adults per first, second, third, fourth and fifth pigeonpea plants of each genotype, respectively, at 45 to 50 days after flowering (medium matured pods stage) and a plant of each genotype was maintained as a control without *M. obtusa* infestation to record actual grain yield. The data on maggot population of *M. obtusa*, pod damage, grain damage and grain yield of selected plants were recorded on 45 days after infestation; and converted into ha basis to work out ETL for *M. obtusa*. The ETL for *M. obtusa* maggot population, pod and grain damage (percent) was calculated by following formulae [16].

Management cost = Cost of plant protection + Cost of seeds

$$\text{Grain threshold} = \frac{\text{Management cost (Rs. per ha)}}{\text{Market value of produce (Rs. per q)}} \times 100$$

$$\text{Regression coefficient} = \frac{\sum XY - [(\sum X \mathbf{x} \sum Y) / N]}{\sum X^2 - [(\sum X^2) / N]} \times 100$$

Where, X = Number of *M. obtusa* maggots or percent pod or grain damage per plant
Y = Yield (q per ha)
N = Number of observations

$$\text{ETL (Economic Threshold Level)} = \frac{\text{Grain threshold}}{\text{Regression coefficient}}$$

## 3. Results and Discussion

The data on determination of the economic threshold level (ETL) through pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) maggot population in different pigeonpea genotypes is presented in Table 1. The ETL of maggot population varied among genotypes under study *i.e.* BSMR-736, BDN-708, BDN-2010-1 and ICP-8863, respectively and ranged from 6.44 to 13.06 maggots per plant with a mean of 7.76 maggots per plant. The highest ETL of 13.06 maggot per plant was observed in BDN-708 and lowest was observed on the genotype, BDN-2010-1 i.e. 6.44 maggots per plant, followed by ICP-8863 (6.71 maggots per plant) and BSMR-736 (7.70 maggots per plant), respectively; with a mean ETL of 7.76 maggots, which is indicating that the management practices against *M. obtusa* can be carried out at this ETL point before crossing economic injury level (EIL).

The data on determination of the economic threshold level (ETL) through pod damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) in different pigeonpea genotypes is presented in Table 2. The ETL of pod damage was varied among genotypes under study *i.e.* BSMR-736, BDN-708, BDN-2010-1 and ICP-8863, respectively and ranged from 2.64 to 8.38 percent per plant with a mean of 4.60 percent. The highest ETL of 8.38 percent pod damage per plant was observed in BDN-708 and lowest was observed on the genotype, BDN-2010-1 *i.e.* 2.64 percent pod damage per plant, followed by ICP-8863 and BSMR-736 *i.e.* 4.75 and 4.79 percent pod damage per plant, respectively; with a mean ETL of 4.60 percent, which is indicating that the management practices against *M. obtusa* can be carried out at this ETL. The results are in accordance with [17], who reported that 2.5 percent pod damage is the ETL of *M. obtusa*. Approximately 20.00 percent pod infestation due to *M. obtusa,* could be considered as the threshold level [18].

The data on determination of the economic threshold level (ETL) through grain damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) in different pigeonpea genotypes is presented in Table 3. The ETL of grain damage was varied among genotypes under study *i.e.* BSMR-736, BDN-708, BDN-2010-1 and ICP-8863, respectively and ranged from 1.09 to 3.56 percent per plant with a mean of 2.05 percent. The highest ETL of 3.56 percent grain damage per plant was observed in BDN-708 and lowest was observed on the genotype, BDN-2010-1 *i.e.* 1.09 percent grain damage per plant, followed by ICP-8863 and BSMR-736 *i.e.* 2.63 and 1.63 percent grain damage per plant, respectively; with a mean ETL of 2.05 percent, indicating that the management practices against *M. obtusa* can be carried out at this ETL. The results are in accordance with [18], who reported that 10.00 percent seed damage from approximately 20.00 percent pod infestation due to *M. obtusa,* could be considered as the threshold level.

**Table 1:** Economic Threshold Level (ETL) for pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) maggots.

| Pl. No. | BSMR-736 | | BDN-708 | | BDN-2010-1 | | ICP-8863 | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Number of *M. obtusa* maggots per plant (X) | Yield (q per ha) (Y) | Number of *M. obtusa* maggots per plant (X) | Yield (q per ha) (Y) | Number of *M. obtusa* maggots per plant (X) | Yield (q per ha) (Y) | Number of *M. obtusa* maggots per plant (X) | Yield (q per ha) (Y) | Number of *M. obtusa* maggots per plant (X) | Yield (q per ha) (Y) |
| 1 | 28.00 | 15.93 | 35.00 | 9.62 | 20.00 | 15.48 | 32.00 | 17.18 | 28.75 | 14.55 |
| 2 | 39.00 | 14.05 | 52.00 | 8.48 | 27.00 | 13.65 | 45.00 | 15.15 | 40.75 | 12.83 |
| 3 | 42.00 | 12.63 | 69.00 | 7.63 | 39.00 | 12.27 | 56.00 | 13.62 | 51.50 | 11.54 |
| 4 | 63.00 | 10.65 | 72.00 | 6.43 | 52.00 | 10.35 | 63.00 | 11.49 | 62.50 | 9.73 |
| 5 | 97.00 | 07.73 | 88.00 | 4.67 | 78.00 | 07.51 | 89.00 | 08.34 | 88.00 | 07.06 |
| 6* | 00.00 | 16.69 | 00.00 | 10.08 | 00.00 | 16.21 | 00.00 | 17.99 | 00.00 | 15.24 |
| ∑ | 269.00 | 77.68 | 316.00 | 46.91 | 216.00 | 75.46 | 285.00 | 83.76 | 271.50 | 70.95 |
| Management cost | | 3500 | | 3500 | | 3500 | | 3500 | | 3500 |
| Market value of produce | | 4560 | | 4560 | | 4560 | | 4560 | | 4560 |
| Grain Threshold | | 0.77 | | 0.77 | | 0.77 | | 0.77 | | 0.77 |
| Regression Coefficient | | 0.10 | | 0.06 | | 0.12 | | 0.11 | | 0.10 |
| ETL | | 7.70 | | 13.06 | | 6.44 | | 6.71 | | 7.76 |

* Control

**Table 2:** Economic Threshold Level (ETL) for pod damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch).

| Pl. No. | BSMR-736 | | BDN-708 | | BDN-2010-1 | | ICP-8863 | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pod damage (%) per plant (X) | Yield (q per ha) (Y) | Pod damage (%) per plant (X) | Yield (q per ha) (Y) | Pod damage (%) per plant (X) | Yield (q per ha) (Y) | Pod damage (%) per plant (X) | Yield (q per ha) (Y) | Pod damage (%) per plant (X) | Yield (q per ha) (Y) |
| 1 | 09.00 | 15.93 | 13.00 | 9.62 | 14 | 15.48 | 21.00 | 17.18 | 14.25 | 14.55 |
| 2 | 12.00 | 14.05 | 24.00 | 8.48 | 19 | 13.65 | 33.00 | 15.15 | 22.00 | 12.83 |
| 3 | 26.00 | 12.63 | 36.00 | 7.63 | 21 | 12.27 | 42.00 | 13.62 | 31.25 | 11.54 |
| 4 | 40.00 | 10.65 | 40.00 | 6.43 | 24 | 10.35 | 50.00 | 11.49 | 38.50 | 09.73 |
| 5 | 55.00 | 07.73 | 62.00 | 4.67 | 28 | 07.51 | 57.00 | 08.34 | 50.50 | 07.06 |
| 6* | 00.00 | 16.69 | 00.00 | 10.08 | 0.00 | 16.21 | 0.00 | 17.99 | 00.00 | 15.24 |
| ∑ | 142.00 | 77.68 | 175.00 | 46.91 | 106.00 | 75.46 | 203.00 | 83.76 | 156.50 | 70.95 |
| Management cost | | 3500 | | 3500 | | 3500 | | 3500 | | 3500 |
| Market value of produce | | 4560 | | 4560 | | 4560 | | 4560 | | 4560 |
| Grain Threshold | | 0.77 | | 0.77 | | 0.77 | | 0.77 | | 0.77 |
| Regression Coefficient | | 0.16 | | 0.09 | | 0.29 | | 0.16 | | 0.17 |
| ETL | | 4.79 | | 8.38 | | 2.64 | | 4.75 | | 4.60 |

* Control

**Table 3:** Economic Threshold Level (ETL) for grain damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch).

| Pl. No. | BSMR-736 | | BDN-708 | | BDN-2010-1 | | ICP-8863 | | Mean | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Grain damage (%) per plant (X) | Yield (q per ha) (Y) | Grain damage (%) per plant (X) | Yield (q per ha) (Y) | Grain damage (%) per plant (X) | Yield (q per ha) (Y) | Grain damage (%) per plant (X) | Yield (q per ha) (Y) | Grain damage (%) per plant (X) | Yield (q per ha) (Y) |
| 1 | 03.00 | 15.93 | 07.05 | 09.62 | 05.61 | 15.48 | 15.08 | 17.18 | 07.69 | 14.55 |
| 2 | 06.13 | 14.05 | 11.38 | 08.48 | 07.56 | 13.65 | 18.34 | 15.15 | 10.85 | 12.83 |
| 3 | 12.60 | 12.63 | 16.40 | 07.63 | 08.15 | 12.27 | 22.90 | 13.62 | 15.01 | 11.54 |
| 4 | 14.71 | 10.65 | 20.63 | 06.43 | 09.95 | 10.35 | 26.91 | 11.49 | 18.05 | 09.73 |
| 5 | 17.07 | 07.73 | 24.80 | 04.67 | 12.18 | 07.51 | 32.98 | 08.34 | 21.76 | 07.06 |
| 6* | 00.00 | 16.69 | 00.00 | 10.08 | 00.00 | 16.21 | 00.00 | 17.99 | 00.00 | 15.24 |
| ∑ | 53.51 | 77.68 | 80.26 | 46.91 | 43.45 | 75.46 | 116.21 | 83.76 | 73.36 | 70.95 |
| Management cost | | 3500 | | 3500 | | 3500 | | 3500 | | 3500 |
| Market value of produce | | 4560 | | 4560 | | 4560 | | 4560 | | 4560 |
| Grain Threshold | | 0.77 | | 0.77 | | 0.77 | | 0.77 | | 0.77 |
| Regression Coefficient | | 0.47 | | 0.22 | | 0.71 | | 0.29 | | 0.37 |
| ETL | | 1.63 | | 3.56 | | 1.09 | | 2.63 | | 2.05 |

* Control

## 4. Conclusion

From the present study, it can be concluded that the economic threshold level (ETL) for the management of *Melanagromyza obtusa* (Malloch) is 7.76 maggots or 4.60 percent pod or 2.05 percent grain damage. It is the best time for the application of need based insecticides with novel mode of action and green chemistry as it fits best according to existing economic and environmental conditions.

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