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Survey of *Melanagromyza obtusa* (Malloch) Infestation in Major Pigeon pea Growing Districts of Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A roving survey was conducted at major pigeonpea growing districts of Karnataka *viz*., Bagalkote, Vijayapura, Kalaburgi and Bidar during *Kharif* seasons of 2022 and 2023. Among the four districts, Bidar consistently recorded the highest pod fly population and per cent damage. In 2022, Bhalki taluk of Bidar district exhibited the highest maggot population (5.12) and pupal count (14.29) per 100 pods, as well as the highest per cent pod damage (20.41) and seed damage (9.62), alongside Bidar taluk. Indi taluk of Vijayapura district recorded the lowest maggot (2.92) and pupal populations (8.96) per 100 pods, with the lowest per cent pod (13.04) and seed (6.31) damage. During 2023, Bhalki taluk again showed the highest maggot (5.37) and pupal populations (15.04) per 100 pods, with the highest per cent pod damage (21.58) and seed damage (10.98). Conversely, Indi taluk recorded the lowest maggot (3.13) and pupal populations (9.88) per 100 pods, with the lowest per cent pod (14.12) and seed (7.49) damage. These findings highlight significant spatial and temporal variations in pod fly infestation and damage within the surveyed districts.

Keywords: Pigeonpea; pod damage; pupal count; roving survey; seed damage; Melanagromyza obtusa.

1. INTRODUCTION

Pigeonpea (*Cajanus cajan*) is a prominent pulse crop widely cultivated in tropical and subtropical regions across approximately 50 countries in Asia, Africa and America. Within Indian agriculture, pigeonpea holds significant importance as a *Kharif* pulse due to its versatile applications, serving as a source of food, feed, fodder and fuel it is playing a crucial role in sustaining agricultural productivity [1]. India leads global pigeonpea production, contributing about 75 per cent of the world's output. Economically, pigeonpea ranks second among pulse crops, following chickpea and constitutes around 20 per cent of total pulse production [2]. Pigeonpea cultivation covers approximately 4.8 million hectares in India, with a total production of 3.7 million metric tons and a productivity of 770 kg/ha [3]. However, pigeonpea production faces significant challenges from insect pests, particularly those affecting flowers and seeds. The crop encounters infestation by about 250 insect species Upadhyay et al., [4] with notable pests including the gram pod borer, *Helicoverpa armigera*, spotted pod borer, *Maruca vitrata*, and pigeonpea pod fly, *Melanagromyza obtusa*. These pests pose substantial threats, causing grain yield losses ranging from 60 to 90 per cent [5].

Among these, the pigeonpea pod fly, *M. obtusa*, is a significant pest in South and Southeast Asia, causing damage from the pod filling stage to maturity [6]. The pest infests pigeonpea as its primary host, may also affect other leguminous crops in the yield loss by pod fly varies from 60 to 80 per cent, influenced by geographical locations, genotypes and climatic conditions, with late and medium-duration genotypes experiencing more damage [7]. The pod fly's concealed activity within the pods makes early detection and pest management challenging, contributing to substantial yield losses in pigeonpea cultivation. Despite the economic importance of pigeonpea, information regarding pod fly incidence and damage is lacking in major pigeonpea growing areas of Karnataka. Hence, a roving survey was carried out to assess the incidence and damage level of *M. obtusa* in pigeonpea.

2. MATERIALS AND METHODS

A roving survey was conducted to assess the incidence and damage caused by the pigeonpea pod fly, *Melanagromyza obtusa* during the pod formation to maturity stages of pigeonpea. The survey was carried out in four districts of northern Karnataka comprised Bagalkote, Vijayapura, Kalaburgi and Bidar. The specific locations within these districts included Bagalkote, Jamkhandi and Mudhol in Bagalkote district. Indi, Sindagi and Muddebihal in Vijayapura district. Kalaburgi, Jevargi and Aland in Kalaburgi district and Bidar, Humnabad and Bhalki in Bidar district. The survey spanned the *Kharif* seasons of 2022 and 2023.

From each taluk two villages were selected in each village, two fields were surveyed, making a total of 48 fields across the four districts. In each surveyed field, 100 pods were randomly collected and examined. The pods were split open to observe and record the number of maggots, pupae and the extent of pod and seed

damage. Observations were recorded at 15-day intervals from the pod formation stage to pod maturation.

The per cent pod and seed damage was calculated based on the following formulas:

Per cent pod damage = Number of damaged pods/Total number of pods X 100

Per cent seed damage = Number of damaged seeds/Total number of seeds X 100

3. RESULTS AND DISCUSSION

During Kharif season-2022 and 2023, a roving survey was conducted across 24 villages in various taluks of the Bagalkote, Vijayapura, Kalaburgi and Bidar districts of Karnataka to assess the incidence and damage caused by the pigeonpea pod fly, *M. obtusa* (Table 1 and Table 2).

Among the various villages surveyed during 2022, Halikhed village in Humnabad taluk had the highest maggot population, with 5.66 maggots per 100 pods. Bagdal village in Bidar taluk recorded the highest pupal count (15.59), per cent pod damage (21.00) and seed damage (10.11). Salotagi village in Indi taluk had the lowest maggot population per 100 pods (2.52), while Lachyan village in Indi taluk recorded the lowest pupal count per 100 pods (8.50) and the lowest per cent pod damage (13.00). The lowest per cent seed damage (6.21) was observed in Salotagi village of Indi taluk. Whereas in 2023, Halikhed village in Humnabad taluk had the highest maggot population, with 5.83 maggots per 100 pods. Bagdal village in Bidar taluk recorded the highest pupal count (16.17), the highest per cent pod damage (22.17) and the highest per cent seed damage (11.17). Salotagi village in Indi taluk had the lowest maggot population per 100 pods (3.08), while Lachyan village in Indi taluk recorded the lowest pupal count per 100 pods (9.50). The lowest per cent pod damage (13.83) was observed in Salotagi village and the lowest per cent seed damage (7.41) was observed in Lachyan village, both in Indi taluk.

In each district, the pod fly population and damage varied across different taluks (Table 3 and Table 4). during 2022 in Bagalkote district, Mudhol taluk recorded the highest maggot population per 100 pods (3.67), followed by Jamkhandi (3.50) and Bagalkote (3.42). The highest pupal count was observed in Mudhol taluk (10.25), followed by Jamkhandi (10.04) and Bagalkote (9.88). Mudhol taluk also had the highest per cent pod damage (15.66), followed by Jamkhandi (15.08) and Bagalkote (14.66). Additionally, the highest seed damage was recorded in Mudhol taluk (7.55%), followed by Jamkhandi (7.35%) and Bagalkote (6.66%). However, during 2023 in Bagalkote district, Mudhol taluk recorded the highest maggot population per 100 pods (4.12), followed by Jamkhandi (3.75) and Bagalkote (3.67). The highest pupal count was observed in Mudhol taluk (11.08), followed by Jamkhandi (10.96) and Bagalkote (10.75). Mudhol taluk also had the highest per cent pod damage (16.96), followed by Jamkhandi (16.33) and Bagalkote (15.79). Additionally, the highest seed damage was recorded in Mudhol taluk (8.51%), followed by Jamkhandi (8.40%) and Bagalkote (8.16%).

During 2022 in Vijayapura district, the highest maggot population per 100 pods was recorded in Muddebihal taluk (3.21), followed by Sindagi (3.04) and Indi (2.92). Muddebihal taluk also recorded the highest pupal count per 100 pods (9.54), followed by Sindagi (9.21) and Indi (8.96). The highest pod damage was observed in Muddebihal (14.20%), followed by Sindagi (13.83%) and Indi (13.04%). Additionally, Muddebihal taluk had the highest seed damage (6.99%), followed by Sindagi (6.69%) and Indi (6.31%). Whereas during 2023 in Vijayapura district, the highest maggot population per 100 pods was recorded in Muddebihal taluk (3.33), followed by Sindagi (3.29) and Indi (3.13). Muddebihal taluk also recorded the highest pupal count per 100 pods (10.42), followed by Sindagi (10.09) and Indi (9.88). The highest pod damage was observed in Muddebihal (15.37%), followed by Sindagi (14.91%) and Indi (14.12%). Additionally, Muddebihal taluk had the highest seed damage (8.06%), followed by Sindagi (7.75%) and Indi (7.49%).

During 2022 in Kalaburagi district, Aland taluk recorded the highest maggot population with 4.46 maggots per 100 pods, followed by Kalaburagi with 4.25 and Jevargi with 3.92. Aland taluk also had the highest pupal count per 100 pods at 11.63, followed by Kalaburagi at 11.00, while Jevargi taluk had the lowest at 10.54. The highest pod damage was observed in Aland at 17.79 per cent, followed by Kalaburagi at 17.00 per cent, with Jevargi having the lowest at 16.37 per cent. Regarding seed damage,

Aland taluk recorded the highest per cent at 8.78, followed by Kalaburagi at 8.19 and Jevargi taluk recorded the lowest at 7.71. However, during the 2023 in Kalaburagi district, Aland taluk recorded the highest maggot population with 4.67 maggots per 100 pods, followed by Kalaburagi with 4.42 and Jevargi with 4.09. Aland taluk also had the highest pupal count per 100 pods at 12.42, followed by Kalaburagi at 11.79, while Jevargi taluk had the lowest at 11.33. The highest pod damage was observed in Aland with 18.96 per cent, followed by Kalaburagi with 18.16 per cent, whereas, Jevargi having the lowest with 17.45 per cent. Regarding seed damage, Aland taluk recorded the highest per cent at 9.89, followed by Kalaburagi at 9.28 and Jevargi taluk recorded the lowest at 8.39.

During 2022 in Bidar district, Bhalki taluk recorded the highest maggot population per 100 pods (5.12), followed by Bidar (4.67) and Humnabad (4.33). Bhalki taluk also had the highest pupal count (14.29), with Bidar (13.54) and Humnabad (12.96) trailing behind. Additionally, Bhalki taluk observed the greatest per cent of pod damage (20.41), followed by Bidar (19.20) and Humnabad (18.62). The highest seed damage was recorded in both Bhalki and Bidar taluk (9.62%), followed by Humnabad (9.08%). Whereas during 2023 in Bidar district, Bhalki taluk recorded the highest maggot population per 100 pods (5.37), followed by Bidar (4.88) and Humnabad (4.46). Bhalki taluk also had the highest pupal population (15.04), followed by Bidar (14.33) and Humnabad (13.79). Additionally, Bhalki taluk recorded the greatest per cent pod damage (21.58), with Bidar (20.37) and Humnabad (19.79) trailing behind. The highest seed damage was also recorded in Bhalki taluk (10.98%), followed by Bidar (10.69%) and Humnabad (10.16%).

Table 1. Average population and damage of pigeonpea pod fly, *M. obtusa* in different surveyed areas during *Kharif* season-2022

District	Taluka	Village	Maggots/ 100 pods	Pupae/100 pods	Pod damage (%)	Seed damage (%)
Bagalkote	Bagalkote	Ankalagi	3.17	10.92	15.08	6.39
		Kaladgi	3.67	8.83	14.25	6.94
	Jamkhandi	Chikkalaki	3.34	11.00	15.42	7.54
		Bidari	3.67	9.08	14.75	7.17
	Mudhol	Bantanur	3.42	11.42	16.33	7.72
		Baragi	3.92	9.08	15.00	7.38
	Mean		**3.53**	**10.05**	**15.14**	**7.19**
Vijayapura	Indi	Salotagi	2.84	9.42	13.08	6.21
		Lachyan	3.00	8.50	13.00	6.41
	Sindagi	Bandal	3.08	9.75	14.00	6.71
		Kannolli	3.00	8.67	13.67	6.67
	Muddebihal	Talikoti	3.00	10.17	14.50	7.07
		Hadagali	3.42	8.92	13.91	6.91
	Mean		**3.06**	**9.24**	**13.69**	**6.66**
Kalaburagi	Kalaburagi	Savalgi	3.75	12.09	17.75	8.67
		Belgumpa	4.75	9.92	16.25	7.72
	Jevargi	Aralgundgi	3.42	11.75	16.83	8.00
		Jeratagi	4.42	9.34	15.91	7.43
	Aland	Bhodhan	3.84	12.92	18.33	8.84
		Dhangapur	5.09	10.33	17.25	8.73
	Mean		**4.21**	**11.06**	**17.05**	**8.23**
Bidar	Bidar	Bagdal	4.42	15.59	21.00	10.11
		Kamthana	4.92	11.50	17.41	9.14
	Bhalki	Jaigaon	3.75	14.84	20.42	9.37
		Siddapurwadi	4.92	11.09	16.83	8.80
	Humnabad	Changlera	4.58	14.08	20.17	10.07
		Halikhed	5.66	5.66	13.77	9.18
	Mean		**4.71**	**12.12**	**18.26**	**9.44**

Table 2. Average population and danage of pigeonpea pod fly, *M. obtusa* in different surveyed areas during season 2023

District	Taluk	Village	Maggots /100 pods	Pupae /100 pods	Pod damage (%)	Seed damage (%)
Bagalkote	Bagalkote	Ankalagi	3.42	11.67	16.16	8.48
		Kaladgi	3.92	9.83	15.41	7.85
	Jamkhandi	Chikkalaki	3.58	11.84	16.75	8.60
		Bidari	3.92	10.08	15.92	8.21
	Mudhol	Bantanur	4.17	12.17	17.75	8.93
		Baragi	4.08	10.00	16.17	8.10
	Mean		**3.85**	**10.93**	**16.36**	**8.36**
Vijayapura	Indi	Salotagi	3.08	10.25	13.83	7.57
		Lachyan	3.17	9.50	14.42	7.41
	Sindagi	Bandal	3.42	10.59	15.08	7.81
		Kannolli	3.17	9.59	14.75	7.70
	Muddebihal	Talikoti	3.09	11.00	15.66	8.09
		Hadagali	3.58	9.83	15.08	8.03
	Mean		**3.25**	**10.13**	**14.80**	**7.77**
Kalaburagi	Kalaburagi	Savalgi	3.92	13.00	18.91	9.70
		Belgumpa	4.92	10.59	17.41	8.87
	Jevargi	Aralgundgi	3.59	12.75	18.00	8.32
		Jeratagi	4.59	9.92	16.91	8.46
	Aland	Bhodhan	4.08	13.84	19.50	9.88
		Dhangapur	5.25	11.00	18.42	9.90
	Mean		**4.39**	**11.85**	**18.19**	**9.19**
Bidar	Bidar	Bagdal	4.67	16.17	22.17	11.17
		Kamthana	5.09	12.50	18.58	10.22
	Bhalki	Jaigaon	3.92	15.84	21.58	10.43
		Siddapurwadi	5.00	11.75	18.00	9.90
	Humnabad	Changlera	4.92	15.08	21.33	11.11
		Halikhed	5.83	5.83	14.55	10.84
	Mean		**4.90**	**12.86**	**19.37**	**10.61**

Table 3. Average population and damage of pigeonpea pod fly, *M. obtusa* in different surveyed areas during Season 2022

District	Taluka	Maggots/100 pods	Pupae/100 pods	Pod damage (%)	Seed damage (%)
Bagalkote	Bagalkote	3.42	9.88	14.66	6.66
	Jamkhandi	3.50	10.04	15.08	7.35
	Mudhol	3.67	10.25	15.66	7.55
	Mean	**3.53**	**10.05**	**15.14**	**7.19**
Vijayapura	Indi	2.92	8.96	13.04	6.31
	Sindagi	3.04	9.21	13.83	6.69
	Muddebihal	3.21	9.54	14.20	6.99
	Mean	**3.06**	**9.24**	**13.69**	**6.66**
Kalaburagi	Kalaburagi	4.25	11.00	17.00	8.19
	Jevargi	3.92	10.54	16.37	7.71
	Aland	4.46	11.63	17.79	8.78
	Mean	**4.21**	**11.06**	**17.05**	**8.23**
Bidar	Bidar	4.67	13.54	19.20	9.62
	Humnabad	4.33	12.96	18.62	9.08
	Bhalki	5.12	14.29	20.41	9.62
	Mean	**4.71**	**12.12**	**18.26**	**9.44**

Table 4. Average population and damage of pigeonpea pod fly, *M. obtusa* in different surveyed areas during *Kharif* season-2023

District	Taluk	Maggots/ 100 pods	Pupae/ 100 pods	Pod damage (%)	Seed damage (%)
Bagalkote	Bagalkote	3.67	10.75	15.79	8.16
	Jamkhandi	3.75	10.96	16.33	8.40
	Mudhol	4.12	11.08	16.96	8.51
	Mean	**3.85**	**10.93**	**16.36**	**8.36**
Vijayapura	Indi	3.13	9.88	14.12	7.49
	Sindagi	3.29	10.09	14.91	7.75
	Muddebihal	3.33	10.42	15.37	8.06
	Mean	**3.25**	**10.13**	**14.80**	**7.77**
Kalaburagi	Kalaburagi	4.42	11.79	18.16	9.28
	Jevargi	4.09	11.33	17.45	8.39
	Aland	4.67	12.42	18.96	9.89
	Mean	**4.39**	**11.85**	**18.19**	**9.19**
Bidar	Bidar	4.88	14.33	20.37	10.69
	Humnabad	4.46	13.79	19.79	10.16
	Bhalki	5.37	15.04	21.58	10.98
	Mean	**4.90**	**12.86**	**19.37**	**10.61**

Variations in pest population and damage across the four districts might be due to differences in varieties, area under cultivation and plant protection measures. The highest per cent damage by pigeonpea pod fly was observed in Bidar and Kalaburagi districts, likely due to the use of long-duration varieties and late sowing. Additionally, these districts had more area under cultivation among the four districts surveyed. In Bidar, the higher population of pigeonpea pod fly may be attributed to maggots, which are positively influenced by temperature and relative humidity. In Bagalkote and Vijayapura, farmers use medium-duration pigeonpea varieties. Vijayapura recorded the lowest per cent damage and pest population, which might be due to a smaller area under cultivation and early sowing compared to the other districts surveyed.

These findings align with those of Minja and Shanower [8] where the per cent seed damage due to pod fly ranged from 0.00 to 46.00 in Kenya, 0.00 to 4.00 in Malawi, 0.00 to 7.00 in Tanzania and 0.00 to 13.00 in Uganda. Similarly, Balikai and Yelshetty [9] revealed 31.00 to 50.00 per cent damage to pigeonpea. Sharma et al. [10], reported that pod fly damage ranging from 25.50 to 36.00 per cent. Saidappa [11] found that among various taluks surveyed, Bijapur had the highest pod damage at 73.40 per cent, whereas Basavana Bagewadi had the least damage at 48.00 per cent. Sunil Kumar [12] found that among the four districts surveyed, the highest average per cent pod damage was recorded in Markhal (22.41) of Bidar, while the minimum damage was observed in Yeramaras (6.48) of Raichur district. Perveen and Kumari [13] also reported that damage to late-maturing pigeonpea varieties by pigeonpea pod fly ranged from 25.00 to 40.00 per cent. Jitendra et al. [14] conducted surveys in various villages of Varanasi district and observed the highest grain damage in Tariya village at 22.41 per cent during 2015-16, while in 2016-17, the highest damage was recorded in Narayanpur village at 30.15 per cent. Manjunath and Prabhu [15] revealed that out of the three districts surveyed, Shiggavi in Haveri had the highest average pod damage at 25.50 per cent, while Ron in Gadag district had the lowest damage at 6.48 per cent.

4. CONCLUSION

Bidar district consistently recorded the highest pod fly population and per cent damage, with Bhalki taluk being particularly affected. In both years, Bhalki taluk exhibited the highest maggot and pupal populations per 100 pods, as well as the highest per cent pod and seed damage. Conversely, Indi taluk in Vijayapura district recorded the lowest levels of maggot and pupal populations, along with the lowest per cent pod and seed damage. These findings underscore the need for targeted pest management strategies, considering the specific conditions and vulnerabilities of each district. Implementing such measures could significantly mitigate pod fly infestation and associated damage, ultimately improving the yield and quality of pigeonpea crops in the affected regions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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