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Management of Pod Fly, *Melanagromyza obtusa* Malloch (Diptera: Agromyzidae) in Pigeonpea Varieties Sown Across Different Dates

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Abstract

An experiment conducted during *kharif,* 2019–20 (July 2019–February 2020) at Zonal Agricultural Research Station, Kalaburagi, University of Agricultural Sciences, Raichur, Karnataka, India on the management of pod fly with recommended chemicals (Imidacloprid 17.8 SL 0.20 ml+jaggary 10 g l^{-1} as first spray at 10 days after pod formation and second spray with Thiamethoxam 25 WG 0.2 g+jaggary 10 g l^{-1} at 15 days after first spray) in pigeonpea varieties sown under different dates revealed, minimum pod damage (21.07%), seed damage (14.51%) and yield (1062.66 kg ha^{-1}) in variety TS 3R. However, significantly higher pod damage, seed damage and yield of 31.47%, 24.89% and 1251.13 kg ha^{-1}, respectively was found in variety BSMR 736. Among different sowing dates, the crop sown on 20th July recorded significantly least pod damage (21.07%) and seed damage (14.06%) compared to 20th August sown crop which recorded significantly higher pod damage of 32.13% and seed damage of 25.86%. Yield was significantly higher in 20th July sown crop (1295.89 kg ha^{-1}) and it was lower in the crop sown on 20th August (1032.90 kg ha^{-1}). With respect to management, minimum pod damage (17.07%) and seed damage (11.52%) was noticed in protected plots while it was maximum in unprotected plots with 35.02 and 26.62% pod and seed damage, respectively. The yield was significantly higher in protected plots (1242.37 kg ha^{-1}) when compared to unprotected plots (1080.65 kg ha^{-1}).

Keywords: Pod fly, pigeonpea, varieties, sowing dates, yield

1. Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is the second important pulse crop grown in India and commonly known as red gram or tur or arhar (Revathi et al., 2015). One of the primary challenges in pigeonpea production is the damage due to insect pests. The most significant economic impact is caused by pests that consume flowers and seeds. A variety of approximately 250 insect species from 8 orders and 61 families have been identified as infesting pigeonpea from its early growth stages to harvest, with virtually no part of the plant escaping infestation (Upadhyay et al., 1998). Among these, the pod fly, *Melanagromyza obtusa*, stands out as a key threat to pigeonpea across South and South-East Asia (Shanower et al., 1999). This pest targets the crop from pod filling stage to maturity. All the immature stages remain within the pod and it is very difficult to monitor the pest without damaging the pod. Pod fly has become a significant concern in major pulse cultivation regions, leading to yield losses, particularly in long-duration varieties (Gopali et al., 2010, 2013; Sharma et al., 2011). It has been responsible for inflicting damage ranging from 21.00 to 38.50% on pods and 12.29 to 19.87% on grains (Khan et al., 2014). Notably, pod fly infestations have resulted in yield losses of 60 to 80% in pigeonpea (Durairaj, 2006).

Pod fly infestation in pods does not exhibit visible external damage symptoms until fully grown larvae chew the pod wall, leaving behind a delicate papery membrane, a "window" through which the adult flies exit. This concealed lifestyle within the pods makes it challenging for farmers to detect pod fly attacks promptly, complicating pest management efforts. This issue is becoming increasingly critical in enhancing both the production and productivity of pigeonpea, especially in subsistence farming conditions. Extensive research over the past three decades has focused on controlling pod fly attacks using chemical methods. The application of insecticides is the primary management strategy for managing pod fly infestations in pigeonpea, as natural enemies effective in this ecosystem are limited (Pathade et al., 2015). Various field studies, such as those conducted by Sahoo et al. (1991), Yadav and Dahiya (2004), and Kumar and Nath (2003), have evaluated the efficacy of different insecticides for pod fly control. Regarding environmental influences, Subharani and Singh (2007) analyzed weather parameters and noted that pod fly infestations are generally not significantly affected by environmental factors, except for relative humidity, which has a notable negative impact on pest infestation levels. Despite efforts, the limited understanding of these dynamics has hindered the development of validated forewarning models to date (Sharma et al., 2011).

Till date, chemicals remain the most effective strategy against pod fly; however, they come with several limitations. Despite two or three applications of insecticides, there is no reliable management of the pest, leading to significant crop losses. Moreover, these insecticides often pose risks to natural predators and can have harmful effects on human health. Further, the sowing dates plays a crucial role in pest incidence, likely due to variations in weather conditions (Cumming and Jenkins, 2011). Early-planted crops experience lower pest populations and consequently yield increases compared to late-planted crops (Prasad et al., 2012). Thus, selecting the appropriate sowing period serves as an essential, cost-effective, and eco-friendly tool in pest management. Similarly, choosing pigeonpea varieties that mature before the peak activity of pod flies can also help avoid pest infestations and reduce losses as well as the number of insecticidal sprays. Therefore, the current study aimed to evaluate the efficacy of recommended chemicals against pod fly in pigeonpea varieties sown across different dates.

2. Materials and Methods

Three pigeonpea varieties of varied duration viz., TS 3R (mid early duration), GRG 811 (medium duration) and BSMR 736 (long duration) were sown in plots of 5.4×4.8 m^2 on three dates viz., 20-07-2019, 05-08-2019 and 20-08-2019 under both protected and unprotected conditions during kharif 2019-20 at Zonal Agricultural Research Station, Kalaburagi, University of Agricultural Sciences, Raichur, Karnataka, India. Kalaburagi is situated in North eastern dry zone of Karnataka between 16º 16’ latitude and 77º 20’ longitudes and at 389 meters above mean sea level. The experiment was laid out in a FRBD with three replications. The crop was raised by following the standard agronomic practices as per the package of practices of UAS Raichur (Anonymous, 2017). In protected plots, pod fly was managed by spraying with the recommended chemicals in package of practices i.e., Imidacloprid 17.8 SL 0.20 ml + jaggary 10g l^{-1} as first spray at 10 days after pod formation and second spray with Thiamethoxam 25 WG 0.2 g+jaggary 10 g l^{-1} at 15 days after first spray (Anonymous, 2017).

For recording observations on pod and seed damage, fifty dry pods, each from five selected plants at harvest were collected from each treatment plot and seeds were separated. These seeds were examined for healthy and infested one and accordingly, the pod and seed damage caused by pod fly was calculated (Pathade et al., 2015). The total yield per treatment was recorded separately for assessing the influence of different treatments on yield and later converted to kg ha^{-1}. The data on pod and seed damage recorded at maturity from unprotected and protected plots was subjected to arc sine transformation. Factorial design with three replications of each treatment was used for statistical analysis to know the effect of factors or treatments and their interaction effect on pod damage, seed damage and yield. Duncan’s multiple range test (DMRT) was applied for comparing the treatments means.

3. Results and Discussion

The pod fly damage varied across varieties irrespective of three dates of sowing. At maturity, minimum pod damage (21.07%) seed damage (14.51%) and yield (1062.66 kg ha^{-1}) was recorded in variety TS 3R. The next best variety with respect to lower damage was GRG 811 which recorded 25.60% pod damage, 17.81% seed damage and 1170.75 kg ha^{-1} yield which was differed statistically from TS 3R and BSMR 736. However, significantly higher pod damage, seed damage and grain yield of 31.47%, 24.89% and 1251.13 kg ha^{-1}, respectively was found in variety BSMR 736 (Table 1).

Among different sowing dates, the crop sown on 20th July recorded significantly least pod damage (21.07%) and seed damage (14.06%) compared to 20th August sown crop which recorded significantly higher pod damage of 32.13% and seed damage of 25.86%. The crop sown on 20th July recorded significantly higher yield of 1295.89 kg ha^{-1} and it was minimum in the crop sown on 20th August (1032.90 kg ha^{-1}). With respect to management, minimum pod damage (17.07%) and seed damage (11.52%) was noticed in protected plots while it was maximum in unprotected plots with 35.02 and 26.62% pod and seed damage, respectively. The yield was significantly higher in protected plots (1242.37 kg ha^{-1}) when compared to unprotected plots (1080.65 kg ha^{-1}) (Table 1).

The interaction among varieties, dates of sowing and protection was also found to be significant. Pod damage (9.60%) and seed damage (5.68%) were significantly lower in protected plots of TS 3R variety sown on 20th July, followed by protected plots of GRG 811 sown on 20th July (12.80% pod damage and 7.50% seed damage) and protected plots of TS 3R sown on 5th August (13.60% pod damage and 7.07% seed damage) which were on par with each other. Pod and seed damage of 17.60 and 10.47%, respectively was noticed in BSMR 736 sown on 20th July in protected plots but it was significantly less compared to other two dates of sowing in same variety under protection. Significantly highest pod (52.80%) and seed damage (46.51%) was noticed in unprotected plots BSMR 736 sown on 20th August. Highest grain yield of 1478.44 kg ha^{-1} was obtained from protected

Table 1: Effect of varieties, sowing dates and management on pod and seed damage due to pod fly and yield

Sl. No.	Treatment details	Pod damage (%)	Seed damage (%)	Yield (kg ha^{-1})
A. Varieties (V)				
1.	V_1: TS 3R	21.07 (26.80)^a	14.51 (21.68)^a	(1062.66)^c
2.	V_2: GRG 811	25.60 (29.89)^b	17.81 (24.38)^b	(1170.75)^b
3.	V_3: BSMR 736	31.47 (33.75)^c	24.89 (29.32)^c	(1251.13)^a
	SEm±	0.33	0.13	7.84
	CD (p=0.05)	0.94	0.37	22.56
B. Dates of sowing (D)				
1.	D_1: 20-07-2019	21.07 (26.79)^a	14.06 (21.38)^a	(1295.89)^a
2.	D_2: 05-08-2019	24.93 (29.50)^b	17.29 (23.94)^b	(1155.74)^b
3.	D_3: 20-08-2019	32.13 (34.15)^c	25.86 (30.05)^c	(1032.90)^c
	SEm±	0.33	0.13	7.84
	CD (p=0.05)	0.94	0.37	22.56
C. Protection (P)				
1.	P_1: Unprotected	35.02 (36.16)^b	26.62 (30.79)^b	(1080.65)^b
2.	P_2: Protected	17.07 (24.13)^a	11.52 (19.46)^a	(1242.37)^a
	SEm±	0.27	0.10	6.40
	CD (p=0.05)	0.77	0.30	18.42

Figures in parentheses are arc sin transformed values; Values within a coloum followed by same letter are not significantly different at (p=0.05) by DMRT

plots of BSMR 736 variety sown on 20th July, followed by protected plots of GRG 811 sown on 20th July which recorded yield of 1385.22 kg ha^{-1}. However, lowest yield of 822.54 kg ha^{-1} was noticed in unprotected plots variety TS 3R sown on 20th August (Table 2).

Irrespective of sowing dates and varieties, the pod and seed damage was significantly minimum in protected plots due to chemical intervention than in unprotected plots. Ghetiya (2010) observed pod fly activity from second fortnight of November and increases up to February, thereby it decreases. The pod fly inserts its eggs into the pods after 10 to 15 days of pod formation. In early maturing varieties the pod filling and maturation completes before December 1st fortnight and hence the variety viz., TS 3R (Mid early duration) escaped or experienced less pod fly damage compared to GRG 811 (Medium duration variety) and BSMR 736 (Long duration). Similarly, the date of sowing also has bearing on pod fly incidence. Early sown crop matures before the reaching of moderate activity of pod fly. Present findings were in accordance with Badiger (2019) who found maximum pod fly population and damage in unprotected plots of long duration variety (BSMR 736) which recorded 32.27 and 18.02% pod and seed damage, respectively compared to 10.31% pod damage and 3.84% seed damage in protected plots of mid early duration variety (TS 3R). However, the damage was least in protected plots of short duration variety (ICPL 87) which recorded pod and seed damage of 6.67 and 3.25%, respectively. The pod fly damage varied across season as well as maturity group of the crop (Lal and singh, 1998). Pod damage (15.87%) and seed damage (6.51%) was significantly lower in 18th June sown pigeonpea as compared to significantly highest pod damage (34.01%) and seed damage (15.42%) in 2nd August sown crop (Sunilkumar, 2015). Srujana and Keval (2013) found plots protected by intervention with thiamethoxam 25 WG @ 75 g a.i. ha^{-1} recorded significantly lower pod damage (17.33%) and seed damage (6.77%) compared to unprotected plots which recorded 33.33 and 15.13% pod and seed damage, respectively. Further, the efficacy of thiamethoxam 25 WG for reducing pod fly damage in pigeonpea was reported by Patel et al. (2014).

Table 2: Interaction effect of varieties, sowing dates and management on pod and seed damage due to pod fly and yield

Sl. No.	Treatment details	Pod damage (%)	Seed damage (%)	Yield (kg ha^{-1})
Interaction (V×D×P)				
1.	$V_1D_1P_1$	24.00 (29.30)^{fg}	15.15 (22.90)^f	(1077.34)^{hi}
2.	$V_1D_1P_2$	9.60 (17.97)^a	5.68 (13.76)^a	(1306.78)^{cd}
3.	$V_1D_2P_1$	28.80 (32.43)^h	19.33 (26.08)^h	(977.95)^j
4.	$V_1D_2P_2$	13.60 (21.59)^b	7.07 (15.39)^b	(1186.56)^e
5.	$V_1D_3P_1$	33.60 (35.42)^i	28.25 (32.10)^l	(822.54)^k
6.	$V_1D_3P_2$	16.80 (24.11)^{cd}	11.56 (19.87)^e	(1004.78)^j
7.	$V_2D_1P_1$	28.80 (32.43)^h	19.33 (26.08)^n	(1194.12)^e
8.	$V_2D_1P_2$	12.80 (20.82)^b	7.50 (15.88)^b	(1385.22)^b

Table 2: Continue...

Sl. No.	Treatment details	Pod damage (%)		Seed damage (%)		Yield (kg ha^{-1})	
9.	$V_2D_2P_1$	34.40 (35.90)^{i}		23.72 (29.13)^{j}		(1070.56)^{i}	
10.	$V_2D_2P_2$	15.20 (22.85)^{bc}		9.04 (17.50)^{c}		(1259.78)^{d}	
11.	$V_2D_3P_1$	40.80 (39.69)^{j}		30.57 (33.56)^{m}		(984.01)^{j}	
12.	$V_2D_3P_2$	21.60 (27.67)^{ef}		16.71 (24.12)^{g}		(1130.78)^{fgh}	
13.	$V_3D_1P_1$	33.60 (35.42)^{i}		26.24 (30.81)^{k}		(1333.45)^{bc}	
14.	$V_3D_1P_2$	17.60 (24.77)^{cd}		10.47 (18.88)^{d}		(1478.44)^{a}	
15.	$V_3D_2P_1$	38.40 (38.28)^{j}		30.44 (33.48)^{m}		(1165.71)^{ef}	
16.	$V_3D_2P_2$	19.20 (25.97)^{de}		14.13 (22.08)^{f}		(1273.89)^{d}	
17.	$V_3D_3P_1$	52.80 (46.61)^{k}		46.51 (43.00)^{n}		(1100.19)^{ghi}	
18.	$V_3D_3P_2$	27.20 (31.43)^{gh}		21.55 (27.65)^{i}		(1155.11)^{efg}	
Interaction		SEm±	CD (p=0.05)	SEm±	CD (p=0.05)	SEm±	CD (p=0.05)
(V×D)		0.58	1.64	0.22	0.64	13.59	39.07
(V×P)		0.47	1.34	0.18	0.52	11.09	31.90
(D×P)		0.47	1.34	0.18	0.52	11.09	31.90
(V×D×P)		0.82	2.32	0.32	1.18	19.22	55.24

Figures in parentheses are arc sin transformed values; Values within a coloum followed by same letter are not significantly different at (p=0.05) by DMRT

4. Conclusion

Recommended package of practice effectively managed pod fly in all three dates sown TS 3R (Early mid duration) and GRG 811 (Medium duration) sown on 20th July. However, RPP's efficacy was moderate for the 2nd crop of GRG 811 (5th August) and BSMR 736 (20th July). Late-sown BSMR 736 (5th and 20th August) and GRG 811 (20th August) required more sprays due to heavier pest loads, highlighting the need for additional measures in long-duration varieties and late sown crop.

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