Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2022; 10(1): 372-376

Received: 05-11-2021
Accepted: 08-12-2021

Srinivas G
Department of Entomology, N.M. College of Agriculture, NAU, Navsari, Gujarat, India

Sushil Kumar
Department of Plant Protection, ASPEE College of Horticulture, NAU, Navsari, Gujarat, India

Corresponding Author:
Sushil Kumar
Department of Plant Protection, ASPEE College of Horticulture, NAU, Navsari, Gujarat, India

Abundance of pigeon pea pests in relation to crop phenology under organic and conventional farming systems

Srinivas G and Sushil Kumar

DOI: https://doi.org/10.22271/j.ento.2022.v10.i1e.8956

Abstract
The abundance of pod borer (*Helicoverpa armigera* Hubner) and pod fly (*Melanagromyza obtusa* Malloch) was studied in organic and conventional farming systems of pigeon pea (cv. Vaishali) at Navsari Agricultural University (NAU), Gujarat. The highest larval population (14.68 ± 2.97 and 12.70 ± 3.11 larvae/ plant in organic and conventional farming systems) and highest pod damage (15.12 ± 5.42 and 13.23 ± 4.57/50 pods) due to pod borer were noticed at the pod formation stage. Correlation of pod borer population and its damage with crop stage was significant and positive ('r' = 0.461 & 0.411 and 'r' = 0.455 & 0.45The highest larval (maggot) population of pod flies was noticed at pod maturity stage (28.31 ± 5.70 and 25.44 ± 5.70 larvae/ 50 pods). Similarly, the highest seed damage due to pod fly was noticed at harvest (76.50 ± 2.83 and 71.67 ± 7.79 %). The correlation of pod fly population and seed damage with crop stage was significant and positive ('r' = 0.746 and 0.736 and 'r' = 0.931 and 0.929).

Keywords: *Helicoverpa armigera*, *Melanoagromyza obtusa*, pigeon pea, farming system

1. Introduction

Pigeonpea, *Cajanus cajan* (L.), is an important legume crop grown in the tropics and subtropics, mostly in Asia, Africa, Latin America and the Caribbean region occupying 6.5 percent of the world's total pulse area and contributing 5.7 percent to the total pulse production. Though, India is the largest producer of pigeon pea, contributing more than 90 percent of the world's production, the productivity has always been a concern. The low productivity of pigeon pea in the country may be attributed to many reasons, among which damage by insect pests is of paramount importance (Mishra *et al.*, 2012) [5]. More than 250 species of insect pests are known to infest pigeonpea at various growth stages in India (Gopali *et al.*, 2010) [1] and as per a conservative estimate, losses due to these insect pests may vary from 27 to 100 percent (Srilaxmi and Paul, 2010) [11]. Amongst many insect pests attacking pigeon pea, gram pod borer, *Helicoverpa armigera* (Hubner) has been a major concern in most parts of the country whereas, pod fly, *Melanagromyza obtusa* (Malloch) is emerging as a serious pest of pigeon pea in Central and South India. Pod borer, *H. armigera* causes 40-50 percent damage to the crop (Pareek and Bhargava, 2003) [6]. The problem of pod borer is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility, fecundity and multivoltine overlapping generations (Sarode, 1999) [9]. On the other hand, the pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae) is the most abnoxious pest causing the grain damage from 20 to 80 percent (Subharani and Singh, 2007) [12]. Shanower *et al.* (1998) [10] indicated seed damage varying from 2 percent to more than 90 percent.

To develop efficient pest management strategies, a thorough knowledge of the abundance of pests in crop phenological stages provides an important basis, especially regarding the mpest management diof fferent farming systems. No systematic efforts have been made to observe the diversity of insect pests in relation to crop phenological stages in both conventional and organic farming systems, with special reference to pigeonpea. Such information on pigeon pea was lacking in south Gujarat. Therefore, the study based on the comparative abundance of insect pests in organic and conventional farming systems was carried out with the objective of the Abundance of insect pests in relation to crop phenology.

2. Materials and Methods

The study based on the abundance of pod borer *H. armigera* and pod fly *M. obtusa* in organic and conventional farming systems was carried out at a certified organic farming unit and pulses research unit of Navsari Agricultural university, Gujarat during 2016-18. The pigeon pea variety Vaishali was grown according to the recommended package of practice in both the organic and conventional farming systems.

The pod borer and pod fly larval populations were counted at the weekly interval by the visual search method (on a whole plant basis) on 25 plants (five plants/spot). Apart from the larval population, their associated pod and seed damages were also recorded by observing randomly collected fifty pods from the field. Pod damage due to pod borer was ascertained by observing large circular bored hole on the pod in both the farming systems whereas, the presence of maggot or pupa detected seed damage due to pod fly tunnelled grain by splitting the pods.

The correlation of insect-pests abundance in relation to crop phenology was studied in each farming system. SPSS 21.0 package was used for correlation. The details of the standard week and crop phenological stages of pigeon pea in both the farming systems are indicated in table 1-2.

3. Results and Discussion

The abundance of major pests and their damage to pigeonpea grown under organic and conventional farming systems was studied in relation to crop phenology and cropping systems. The results obtained in the investigation are presented hereunder:

3.1 Overall assessment

3.1.1 Pod borer larval population and pod damage (%)

Fluctuation of pod borer population at all the crop stages of pigeonpea grown under organic and conventional farming systems indicated the highest population of pod borer at the pod formation stage of the crop (14.68 ± 2.97 and 12.70 ± 3.11 larvae/ plant) followed by 10.70 and 8.67, 6.89 and 4.54, 2.96 and 1.77, 1.32 and 0.99 and 1.04 and 0.49 larvae/plant at flowering/pod formation stage, pod maturity, flowering, vegetative and harvesting stages of the crop in both organic and conventional farming systems, respectively (Overall average 6.28 ± 6.18 and 5.00 ± 5.36 larvae/ plant). A higher population of pod borer was noticed at the pod formation stage in both the farming systems, which might be due to the preference of immature pods for the pest under discussion. Thus, it may be concluded that the pod formation stage is the most preferred stage for pod borer invasion (Table 1, Fig. 1).

The results of the present investigation are in accordance with Khokhar and Singh (1983) [2], who in turn reported the appearance of pod borer, *H. armigera* at vegetative, flowering and pod stages. They also observed the appearance of pod fly, *M. obtusa*, on a late-maturing local variety of pigeon pea in September - April when the crop was in the pod stage. Reddy *et al.* (1998) [8] reported that pod borer, *H. armigera* attained major pest status from flowering to the pod maturity stage of the crop, while *M. obtusa* attained major pest status from the pod filling to the pod maturing stage of the crop which supports the present findings.

Similarly, the highest pod damage due to pod borer was noticed at the pod formation stage of the crop (15.12 ± 5.42 and 13.23 ± 4.57) followed by 12.87 and 10.81, 6.80 and 5.93 and 1.38 and 0.91 percent at flowering/pod formation stage, pod maturity and harvesting stages of the crop in both organic and conventional farming systems, respectively (Overall average 6.53±6.97 and 5.59 ± 6.06 %). Higher pod damage due to pod borer was noticed at the pod formation stage and might be attributed to the preference of immature pods by the larva. Thus, it may be concluded that the pod formation stage is the most preferred stage for pod borer invasion (Table 1, Fig. 2).

The correlation of pod borer population and its pod damage with crop stage was significant and positive (‘r’ = 0.461 and 0.411) and (‘r’ = 0.455 and 0.451) in organic and conventional farming systems, respectively implying that advancement in crop stage correspondingly led to increased pod borer population and its pod damage on pigeon pea in both the farming systems, respectively (Table 1).

3.1.2 Pod fly larval population and seed damage (%)

It is evident from the Table 2 and Fig. 3 that the highest population of pod fly was noticed at the pod maturity stage of the crop (28.31 ± 5.70 and 25.44 ± 5.70 larvae/ 50 pods), followed by 21.50 and 20.40, 10.92 and 8.69, 6.83 and 6.02 larvae/ 50 pods at pod formation, flowering/pod formation and harvesting stages of the crop in both organic and conventional farming systems respectively (Overall average 10.71±11.34 and 9.57±10.47 larvae/ 50 pods). A higher population of pod fly was noticed at pod maturity, which might be due to the preference of matured seeds for the pest under discussion.

Mahalle (2008) [4] and Rana *et al.* (2008) [7] also reported that pod borer, pod fly, pod bug and red gram plume moth appeared at about 119 days old crop *i.e.* reproductive stage and were available up to the maturity stage of the crop which supports the present findings. Similarly, Landge (2009) [3] reported that pod borer, pod fly, pod bug and red gram plume moth appeared at about 111 days old crop *i.e.* reproductive stage and remained active up to the crop’s maturity.

Similarly, the highest seed damage due to pod fly was noticed at the harvesting stage of the crop (76.50±2.83 and 71.67 ± 7.79 larvae/ 50 pods) followed by 52.59 and 47.93, 31.16 and 29.81, 11.85 and 10.17 percent at pod maturity, pod formation, and flowering/pod formation stages of the crop in both the farming systems, respectively (Overall average 21.08±24.89 and 19.47±23.19 %) (Table 3 and Fig. 3).

The correlation of pod fly population and its seed damage with crop stage was significant and positive (‘r’ = 0.746 and ‘r’ = 0.931) and (‘r’ = 0.736 and ‘r’ = 0.929) implying that advancement in crop stage correspondingly increased pod fly population and its seed damage in both the farming systems respectively (Table 2).

Table 1: Fluctuation of pod borer larval population and pod damage on pigeon pea in relation to crop phenology and farming system

SMW	Crop Stage	Pod borer *H. armigera* larva/plant					
		2016-17		2017-18		Pooled(2016-18)	
		ORG	CNV	ORG	CNV	ORG	CNV
33-41	Vegetative Av. ± SD	1.2±0.51	0.90±0.31	1.44±0.68	1.07±0.41	1.32±0.59	0.99±0.36
42-43	Flowering Av. ± SD	2.72±0.85	1.64±0.06	3.19±1.09	1.89±0.18	2.96±0.97	1.77±0.12
44-49	Flowering/ Pod formation Av. ± SD	10.32±4.24	8.21±3.97	11.08±4.25	9.12±4.02	10.70±4.24	8.67±3.99
50-2	Pod formation Av ±SD	14.08±3.24	12.35±3.38	15.28±2.73	13.05±2.84	14.68±2.97	12.70±3.11
3-6	Pod maturity Av ±SD	7.06±2.98	4.60±2.03	6.72±3.24	4.47±1.47	6.89±3.09	4.54±1.74

7-8	Harvesting Av + SD	1.07±1.51	0.00	1.00±1.41	0.98±1.39	1.04±1.46	0.49±0.69
Overall average		6.09±6.00	4.80±5.27	6.46±6.37	5.21±5.46	6.28±6.18	5.00±5.36
Correlation coefficient (r) v/s crop phenology		0.472*	0.402*	0.449*	0.418*	0.461*	0.411*
		Pod borer *H. armigera* pod damage (%)					
33-41	Vegetative Av + SD	0.00	0.00	0.00	0.00	0.00	0.00
42-43	Flowering Av + SD	0.00	0.00	0.00	0.00	0.00	0.00
44-49	Flowering/ Pod formation Av + SD	12.53±3.28	10.50±3.53	13.20±3.40	11.12±3.58	12.87±3.33	10.81±3.55
50-2	Pod formation Av + SD	14.67 ± 5.37	12.74 ± 4.64	15.56 ± 5.49	13.71 ± 4.51	15.12 ± 5.42	13.23 ± 4.57
3-6	Pod maturity Av + SD	6.45±1.38	5.74±0.65	7.15±1.03	6.13±0.91	6.80±1.20	5.93±0.75
7-8	Harvesting Av + SD	1.14±1.61	0.68±0.96	1.61±2.28	1.13±1.60	1.38±1.94	0.91±1.28
Overall average		6.31±6.80	5.39±5.91	6.74±7.15	5.79±6.23	6.53±6.97	5.59±6.06
Correlation coefficient (r) v/s crop phenology		0.445*	0.442*	0.465*	0.458*	0.455*	0.451*

SMW- Standard meteorological week; ORG- Organic farming system, CNV- Conventional farming system *Significant at 5% level

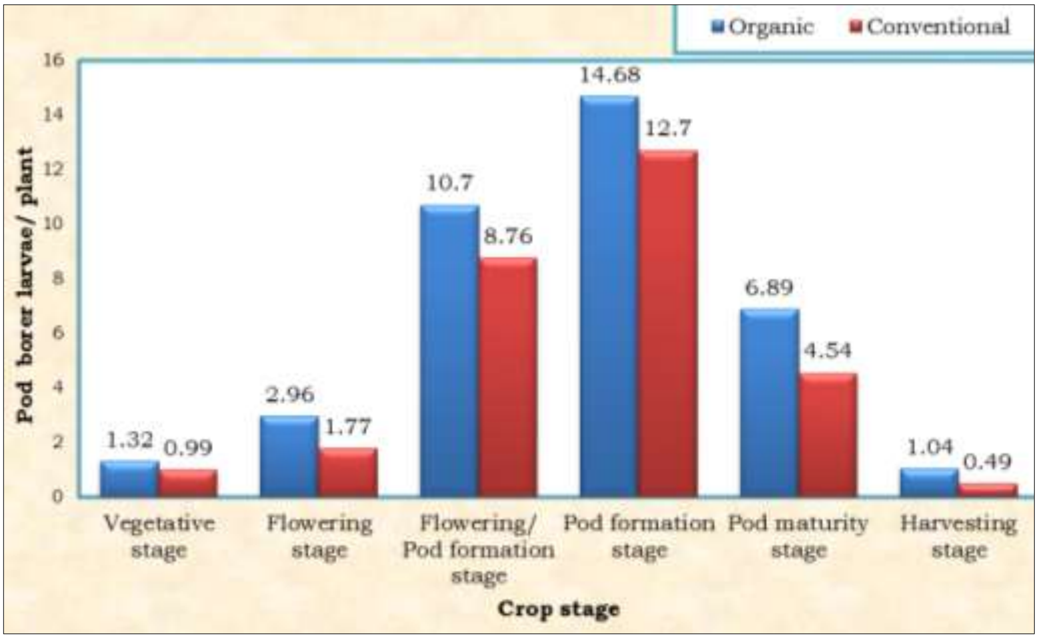

Fig 1: Fluctuation of pod borer, *H. armigera* on pigeon pea in relation to crop phenology in organic and conventional farming systems

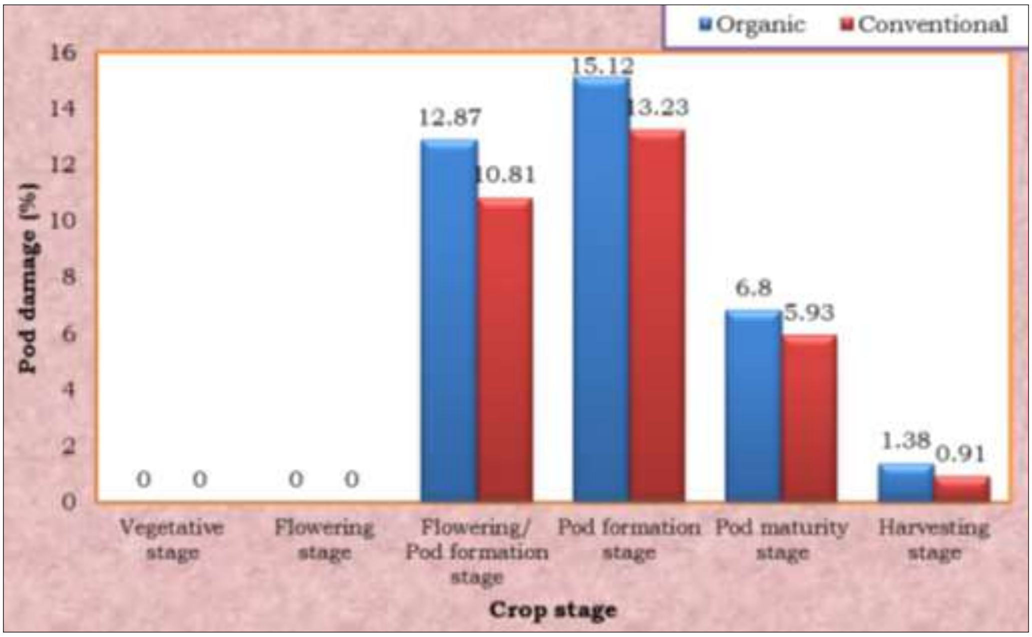

Fig 2: Pod damage due to pod borer, *H. armigera* on pigeon pea in relation to crop phenology in organic and conventional farming systems

Table 2: Fluctuation of pod fly larval population and seed damage on pigeon pea in relation to crop phenology and farming system

SMW	Crop Stage	Pod fly *M. obtusa* larva/plant					
		2016-17		2017-18		Pooled(2016-18)	
		ORG	CNV	ORG	CNV	ORG	CNV
33-41	Vegetative Av + SD	0.00	0.00	0.00	0.00	0.00	0.00

42-43	Flowering Av ± SD	0.00	0.00	0.00	0.00	0.00	0.00
44-49	Flowering/ Pod formation Av ± SD	11.25±5.28	10.46±4.76	10.58±4.80	6.91±5.08	10.92±5.02	8.69±4.66
50-2	Pod formation Av ± SD	21.40±4.00	20.29±3.72	21.60±4.33	20.50±4.42	21.50±4.15	20.40±4.07
3-6	Pod maturity Av ± SD	27.74 ±5.19	25.63±3.50	28.87±6.24	25.24±7.93	28.31±5.70	25.44±5.70
7-8	Harvesting Av ± SD	6.78±8.51	6.28±8.03	6.88±8.15	5.76±7.01	6.83±8.33	6.02±7.52
Overall average		10.68±11.19	9.98±10.37	10.74±11.51	9.16±10.71	10.71±11.34	9.57±10.47
Correlation coefficient (r) v/s crop phenology		0.745**	0.749**	0.745**	0.713**	0.746**	0.736**
		Pod fly *M.obtusa* Seed damage (%)					
33-41	Vegetative Av ± SD	0.00	0.00	0.00	0.00	0.00	0.00
42-43	Flowering Av ± SD	0.00	0.00	0.00	0.00	0.00	0.00
44-49	Flowering/ Pod formation Av. ± SD	11.97±3.69	11.06±3.56	11.73±3.18	9.27±4.11	11.85±3.39	10.17±3.79
50-2	Pod formation Av ± SD	31.30±9.77	29.85±8.53	31.02±9.20	29.77±9.31	31.16±9.46	29.81±8.88
3-6	Pod maturity Av ± SD	52.96±10.05	47.87±7.69	52.21±9.30	47.99±6.73	52.59±9.62	47.93±7.19
7-8	Harvesting Av ± SD	76.98±4.67	71.14±10.61	76.02±0.99	72.20±4.98	76.50±2.83	71.67±7.79
Overall average		21.22±25.09	19.62±23.05	20.94±24.70	19.32±23.36	21.08±24.89	19.47±23.19
Correlation coefficient (r) v/s crop phenology		0.929**	0.931**	0.932**	0.925**	0.931**	0.929**

SMW- Standard meteorological week; ORG- Organic farming system, CNV- Conventional farming system *Correlation is significant at a 1% level

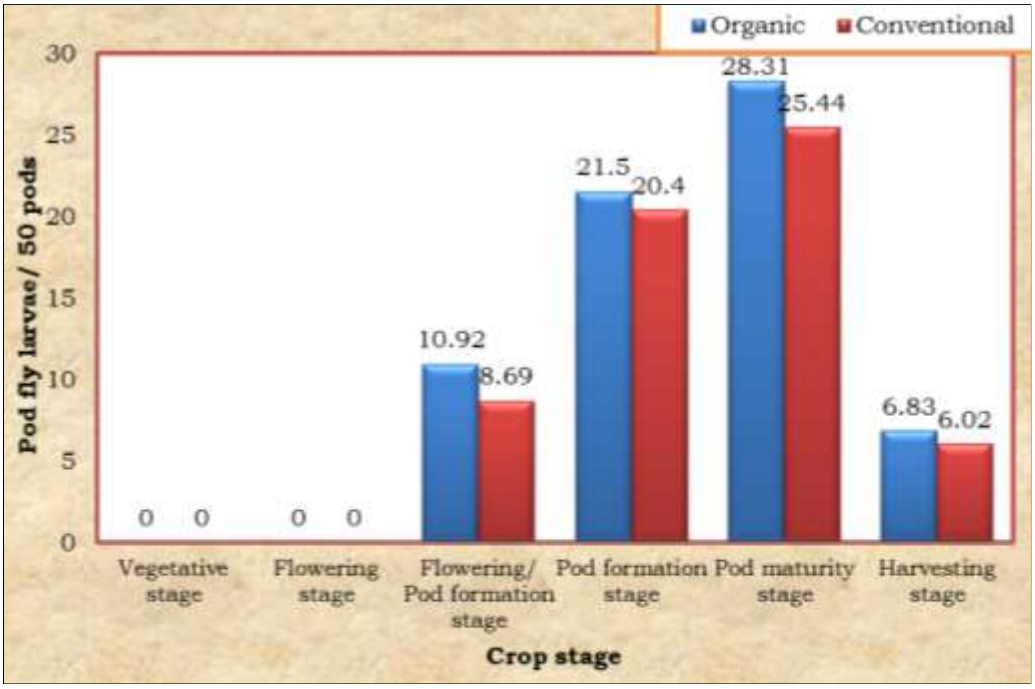

Fig 3: Fluctuation of pod fly, *M. obtusa* on pigeon pea in relation to crop phenology in organic and conventional farming systems

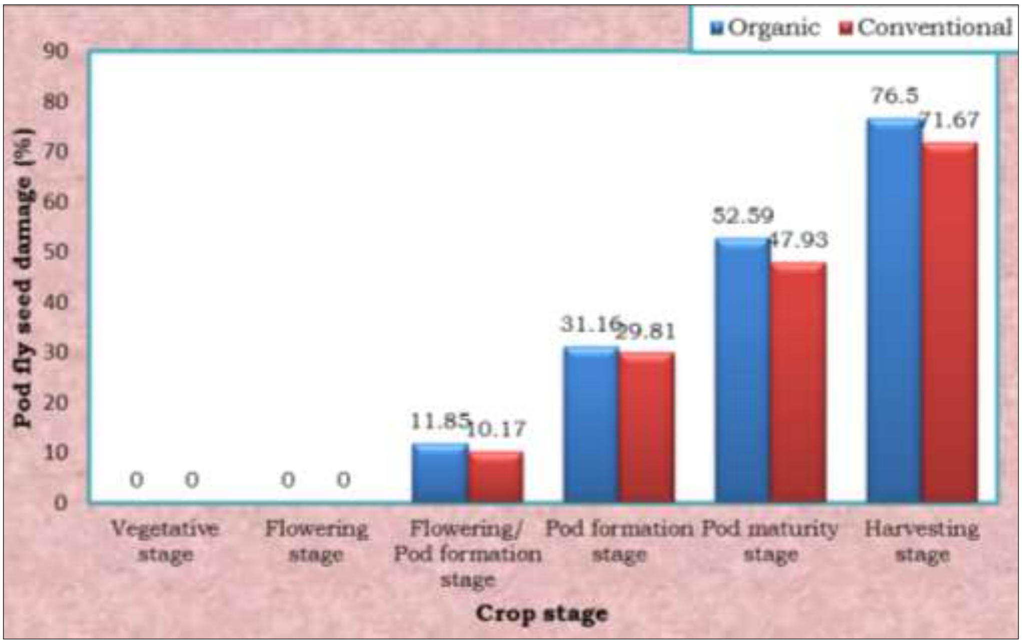

Fig 4: Seed damage by pod fly, *M. obtusa* on pigeon pea in relation to crop phenology in organic and conventional farming systems

4. Conclusion
The highest larval population and highest pod damage were noticed at the pod formation stage of pigeon pea in both organic and conventional farming systems. The correlation of the pod borer population and its damage with crop stage was significant and positive. The highest larval (maggot) population of pod fly (*Melanagromyza obtusa* Malloch) was noticed at the pod maturity stage in both the farming systems. Similarly, the highest seed damage due to pod fly was noticed at harvest. The correlation between pod fly population and seed damage with crop stage was significant and positive.

5. References

1. Gopali JB, Teggelli RD, Mannur M, Yelshetty S. Web is forming lepidopteran, *Maruca vitrata* (Geyer): an emerging and destructive pest in pigeon pea. Karnataka J Agric. Sci. 2010;23:35-38.
2. Khokhar KS, Singh Z. Insect pests associated with Pigeon pea at Hissar, International Chickpea and Pigeon pea News Letter. 1983;2:43-44.
3. Landge SS. Studies on pest complex of pigeon pea, *Cajanus cajan* and their management under late sown condition. M.Sc.(Ag.) A thesis submitted to Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, 2009, 1-164.
4. Mahalle SC. Studies on pest complex of Pigeon pea *Cajanus cajan* L. and management of pod borer complex. M.Sc. (Ag.) A thesis submitted to JNKVV Jabalpur. 2008
5. Mishra, MK., Singh, RP. and Ali, S. Chemical control and avoidable yield losses of pigeon pea due to insect pests. Ann. Pl. Protec. Sci. 2012;20:306-309.
6. Pareek PL, Bhargava MC. Estimation of avoidable losses in vegetables caused by borers under the semi-arid condition of Rajasthan. Insect Environment. 2003;9:59-60.
7. Rana NS, Rana DK, Gupta A, Shukla BC, Sharma RN. Study of population dynamics of insect pests of pigeon pea. Presented in “National Conference on Pest Management Strategies for food security” held at College of Agriculture, I.G.K.V., RAIPUR, C.G. (INDIA), from May 2-3. 2008, pp. 33.
8. Reddy CN, Singh Y, Singh VS. Pest complex and their succession on pigeon pea variety P-33. Ind. J. of Ent. 1998;60(4):334-338.
9. Sarode SV. Sustainable management of *Helicoverpa armigera* (Hubner). Pestology. 1999;13(2):279-284.
10. Shanower TG, Lal SS, Bhagwat VR. Biology and management of *Melanagromyza obtusa* Malloch (Diptera: Agromyzidae). Crop Protection. 1998;17:249-263.
11. Srilaxmi K, Paul R. Diversity of insect pests of pigeon pea [*Cajanus cajan* (L.) Millsp.] and their succession in relation to crop phenology in Gulbarga, Karnataka. The Ecoscan. 2010;4:273-276.
12. Subharani S, Singh TK. Influence of meteorological factors on population dynamics of pod fly, *M. obtusa* (Diptera: Agromyzidae) in pigeonpea under agro-climatic conditions of Manipur. Ind. J. Ent. 2007;69(1):78-80.