PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 12(2): 1-7
https://doi.org/10.14719/pst.8063

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RESEARCH ARTICLE

Assessing the performance of pigeon pea varieties against major pod borer complex from Eastern part of India

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OPEN ACCESS

ARTICLE HISTORY
Received: 04 March 2025
Accepted: 31 March 2025
Available online
Version 1.0 : 15 April 2025
Version 2.0 : 23 April 2025

Check for updates

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

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Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
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CITE THIS ARTICLE
Bilash CD, Sandip P, Suraj S, Nayan Kishor A, Shubham P, Selvaraj C, Dhar P, Samanta A. Assessing the performance of pigeon pea varieties against major pod borer complex from Eastern part of India. Plant Science Today. 2025; 12(2): 1-7. https://doi.org/10.14719/pst.8063

Abstract

Pod borer complex in pigeon pea are the major constraints for successful cultivation with drastically yield reduction. Therefore, varietal evaluation of pigeon pea against major pod borer complex was carried out at the experimental farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India for two consecutive years. A total of 13 pigeon pea varieties such as BAHAR, PUSA-9, MA6, ASHA, PUSA2001, ICPL 87, PUSA992, PUSA991, MARUTI, CORG 9701, UPAS 120, BRG 2, NDA1 were sown in 20 m^2 plot with three replication using randomized block design. Number of larvae of *Helicoverpa armigera and Maruca vitrata* were recorded from 10 randomly selected plants at weekly intervals from flowering to maturity of pods whereas fifty pods were screened for *Melanagromyza obtusa* at pod formation, pod filling and pod maturity stages. The pooled data of two years results showed a significant variation of pod borer infestation among the varieties of pigeon pea. The study showed that among the screened varieties, Pusa 9, Pusa 991 and MA 6 exhibited the minimum infestation level of *H. armigera* (0.35, 0.43 and 0.54 larvae/plant), *M. vitrata* (1.54, 1.69 and 2.08 larvae/plant) at all pods developmental stages. The similar performance of these varieties was also noticed against *M. obtusa*. Therefore, the study identified some promising varieties which may be useful for future breeding programme and these varieties will be also suitable in the integrated pest management programme of pigeon pea.

Keywords

Helicoverpa armigera; *Maruca vitrata*; *Melanagromyza obtusa*; pigeon pea; varietal performance

Introduction

In India, pigeon pea (*Cajanus cajan* L. Millsp.) is an important pulse crop and it is usually recognised as red gram, tur or arhar (1). Pigeon peas are the second most important kharif grain legume in India, after chickpeas. They are mostly cultivated under rainfed environments. Pigeon peas continue to be an essential part of most Indians' diets because, dal, or thick soup, is prepared from the dehulled split cotyledons of pigeon pea seeds and is typically consumed with rice. When it is combined with other cereals, they offer the ideal combination of vegetarian protein components with significant biological value and a valuable source of protein. Pigeon peas also enrich the soil through biological nitrogen fixation. In comparison to dal pigeon pea, the green seeds have higher digestibility levels of protein (66.8 %), fat (2.3 %) and crude fiber (8.2 %). When it comes to trace and mineral elements, the green seeds outperform the other ones in terms of phosphorous by 28.2 %, potassium by 17.2 %, zinc by 48.3 %, copper by 20.9 % and iron by 14.7 %. On the other hand, the dal pigeon pea has 10.8% more manganese and 19.2 % more calcium (2). India is the top producer of pigeon peas with 4.34 million tonnes produced from 5.05 million ha of acreage (3) with a productivity of 859 kg/ha. In 2020, India accounted for 77.61 % of the world's pigeon pea production (4). It is commonly grown in Tamil Nadu, Karnataka, Gujarat, Bihar, West Bengal, Kerala, Punjab, Odisha, Madhya Pradesh, Haryana, Uttar Pradesh and a few northeastern states (5). Numerous abiotic and biotic factors limit the productivity of pigeon pea, which causes a sharp decline in yield and harvests low yields compared to potential yields. Among the biotic stressors, weeds, diseases and insect pests are the broadest obstacles to getting the desired yields. Insect pests are a major factor contributing to the low yields of pigeon pea, damaging the crop at various growth stages. Around 300 species of insect pests attack pigeon pea (6). Significant threats come from pests that feed on buds, flowers, pods and grains. Major pod borers include the gram pod borer, *Helicoverpa armigera* (Hubner), the plume moth, *Exelastis atomosa* (Walshingham) and the pod fly, *Melanagromyza obtusa* (Malloch) (7-9). These pests render the damaged grain unfit for consumption, drastically affecting yields. Pod damage caused by the borer complex has been reported to range from 20 to 72 % (10, 11). In northern India, grain yield loss due to *M. obtusa* can reach up to 71 % (12), while in southern India, grain damage can be as high as 68 % (13). The incidence and yield loss caused by *M. vitrata* in pigeon pea also vary across seasons and locations (14, 15). It has been claimed that over 250 insect pests have attacked pigeon peas; however, *Helicoverpa armigera*, *Melanagromyza obtusa*, *Maruca vitrata* and *Clavigralla gibbosa* have caused significant harm to crop yield (16, 17). *M. vitrata* is a major insect pest of many edible legumes in various regions of America, Asia and Africa (18). A total of seventeen insect species are reported from Uttar Pradesh (19). To overcome this problem, farmers use insecticides to control insect pests. Since insecticides are hazardous substances, they may be harmful to people, animals and wildlife. With the use of single insecticide frequently, insects become resistant to it. The most adverse effect of insecticides is that they eliminate the natural enemies such as parasitoids, predators, as well as beneficial pollinators and cause the imbalance environment. The conservation of natural enemies and the adoption of resistant cultivars are the main pillars of integrated pest management. Therefore, identification of suitable tolerant varieties of crop to combat insect pest problem may be an alternative option to reduce the pesticides load in the environment. There has been significant advancement in the screening process for *Helicoverpa armigera* resistance (20). Pulses are perfect for taking advantage of the resistance phenomenon to effectively and economically manage insect infestations (21). Considering the above background, the present study was conducted to assess the performance of some pigeon pea varieties against major pod borer complex under eastern India.

Materials and Methods

Field experiment

Varietal evaluation of pigeon pea against major pod borer complex was carried out at the experimental farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal, India for two consecutive years of 2013-2015. A total of 13 pigeon pea varieties such as BAHAR, PUSA-9, MA6, ASHA, PUSA2001, ICPL 87, PUSA992, PUSA991, MARUTI, CORG 9701, UPAS 120, BRG 2, NDA1 were sown in the 1st week of July in 20 m^2 plot with three replications maintaining row to row distance 60 cm and plant to plant spacing 20cm. All the pigeon pea varieties were obtained from the Indian Institute of Pulses Research (IIPR), Kanpur, India. Before sowing, seeds treatment was done using *Trichoderma viride* at the rate of @ 5g per kg of seed. The common agronomic managements were applied for growing the all the verities without any measure for insect pests' management.

Observation of pod borers

Number of larvae of *M. vitrata* were recorded from 10 randomly selected plants (tagged) discarding the border effects at weekly intervals from flowering (starting from end of October) to maturity of pods (up to mid-February). Number of *Helicoverpa* larvae were recorded from the same tagged plants at weekly interval starting from pod formation stage (end of December) to maturity of pods (mid-February). Fifty pods were harvested for recording of number of maggots and pupae of pod fly at three different developmental stages of pod *viz.* pod formation, pod filling and pod maturity.

Statistical analysis

The data on larval population of different lepidopteran pests (*M. vitrata* and *H. armigera*) and number of maggot and pupae of dipteran pest (*M. obtusa*) infesting different varieties were transformed into square root values and then data were subjected to analysis of variance (ANOVA) as randomized block design (22). The critical difference at 5 % level of significance were calculated to draw logical conclusions.

Results and Discussion

Performance of different pigeon pea varieties against Helicoverpa armigera during two consecutive seasons

The number of larvae of *H. armigera* in different pigeon pea varieties for two consecutive years is presented in Table 1. During season I, the results revealed that the population of *H. armigera* larvae gradually increased up to 5th week of observation and suddenly decreased at 6th week of observation. There was no infestation in MA 6, Pusa 9 and Pusa 991 during first week of observation, but all varieties were infested at second week after pod formation. At second week, the minimum infestation was found in Pusa 9 (0.10 larvae/plant) and Pusa 991 (0.10 larvae/plant). The increasing trend of larval infestation were found in MA6 (0.20 larvae/plant), CORG 9701 (0.20 larvae/plant), Pusa 992 (0.40 larvae/plant), Bahar (0.50 larvae/plant), BRG2 (0.70 larvae/plant), ICPL87 (0.80 larvae/plant), NDA1 (0.90 larvae/plant), UPAS 120 (1.20 larvae/plant), ASHA, MARUTI (1.40 larvae/plant). The maximum infestation was in Pusa 2001 (1.60 larvae/plant). Almost the similar trend

Table 1. Performance of different pigeon pea varieties against *Helicoverpa armigera* during two consecutive seasons

Variety	Number of larvae of *Helicoverpa armigera* (larvae/plant) at different weeks intervals													
	Season I							Season II						
	1st	2nd	3rd	4th	5th	6th	Mean	1st	2nd	3rd	4th	5th	6th	Mean
MA6	0.00 (0.71)	0.20 (0.82)	0.50 (0.99)	0.70 (1.09)	1.40 (1.38)	0.70 (1.09)	0.58 (1.04)	0.00 (0.71)	0.20 (0.83)	0.40 (0.94)	0.70 (1.09)	1.40 (1.38)	0.30 (0.89)	0.50 (1.00)
Bahar	0.30 (0.89)	0.50 (0.99)	0.90 (1.18)	1.30 (1.34)	1.90 (1.54)	0.90 (1.18)	0.97 (1.21)	0.30 (0.89)	0.60 (1.04)	0.80 (1.14)	1.20 (1.30)	1.80 (1.51)	0.60 (1.05)	0.88 (1.18)
Asha	1.30 (1.33)	1.40 (1.38)	1.80 (1.51)	1.90 (1.54)	2.60 (1.76)	1.80 (1.51)	1.80 (1.52)	1.00 (1.22)	1.10 (1.26)	1.50 (1.41)	1.80 (1.51)	2.50 (1.73)	1.30 (1.34)	1.53 (1.43)
Pusa 9	0.00 (0.71)	0.10 (0.77)	0.30 (0.87)	0.50 (0.99)	1.20 (1.30)	0.40 (0.94)	0.42 (0.96)	0.00 (0.71)	0.00 (0.71)	0.10 (0.77)	0.40 (0.91)	1.20 (1.30)	0.00 (0.71)	0.28 (0.88)
Pusa 2001	1.40 (1.37)	1.60 (1.45)	2.10 (1.61)	2.30 (1.66)	3.10 (1.90)	1.90 (1.55)	2.07 (1.60)	1.20 (1.29)	1.30 (1.34)	1.70 (1.47)	1.90 (1.55)	2.80 (1.81)	1.50 (1.41)	1.73 (1.49)
Pusa 991	0.00 (0.71)	0.10 (0.77)	0.50 (1.00)	0.50 (0.98)	1.40 (1.38)	0.20 (0.82)	0.45 (0.97)	0.00 (0.71)	0.20 (0.83)	0.30 (0.89)	0.60 (1.05)	1.40 (1.34)	0.00 (0.71)	0.42 (0.96)
Maruti	1.30 (1.33)	1.40 (1.37)	1.80 (1.51)	2.10 (1.61)	2.70 (1.79)	1.90 (1.55)	1.87 (1.54)	1.00 (1.22)	1.20 (1.30)	1.70 (1.48)	1.80 (1.51)	2.70 (1.79)	1.00 (1.19)	1.57 (1.44)
ICPL 87	0.70 (1.09)	0.80 (1.13)	1.30 (1.34)	1.60 (1.45)	2.30 (1.66)	1.30 (1.33)	1.33 (1.35)	0.60 (1.04)	0.90 (1.18)	1.20 (1.28)	1.30 (1.34)	2.10 (1.61)	0.70 (1.06)	1.13 (1.28)
CORG 9701	0.20 (0.84)	0.20 (0.83)	0.60 (1.04)	0.80 (1.14)	1.60 (1.44)	0.70 (1.08)	0.68 (1.09)	0.10 (0.77)	0.40 (0.94)	0.60 (1.04)	0.90 (1.16)	1.50 (1.41)	0.40 (0.93)	0.65 (1.07)
NDA 1	0.80 (1.14)	0.90 (1.17)	1.50 (1.41)	1.70 (1.48)	2.30 (1.67)	1.60 (1.45)	1.47 (1.40)	0.70 (1.06)	0.90 (1.18)	1.20 (1.30)	1.50 (1.41)	2.40 (1.70)	0.80 (1.14)	1.25 (1.32)
Pusa 992	0.30 (0.89)	0.40 (0.94)	0.80 (1.14)	1.10 (1.26)	1.80 (1.52)	0.70 (1.08)	0.85 (1.16)	0.30 (0.88)	0.60 (1.04)	0.60 (1.02)	1.00 (1.21)	1.70 (1.48)	0.50 (0.99)	0.78 (1.13)
BRG 2	0.50 (0.99)	0.70 (1.09)	1.20 (1.30)	1.40 (1.37)	2.10 (1.60)	1.00 (1.21)	1.15 (1.28)	0.50 (0.99)	0.80 (1.13)	0.90 (1.18)	1.30 (1.34)	1.80 (1.52)	0.60 (1.04)	0.98 (1.22)
Upas 120	1.10 (1.26)	1.20 (1.30)	1.70 (1.47)	1.90 (1.53)	2.40 (1.70)	1.80 (1.51)	1.68 (1.47)	0.80 (1.13)	1.00 (1.20)	1.30 (1.34)	1.80 (1.51)	2.40 (1.70)	1.20 (1.30)	1.42 (1.38)
SEm±	0.072	0.078	0.086	0.095	0.086	0.094	0.035	0.081	0.086	0.105	0.102	0.095	0.103	0.036
CD (P≤0.05)	0.211	0.229	0.251	0.276	0.250	0.273	0.101	0.235	0.250	0.306	0.296	0.278	0.300	0.106

Data in parenthesis are the square root transformed values √ (x+0.5)

was observed in 3rd, 4th and 5th week observations where the population of larvae had increased gradually. In 6th week observation, the population of *H. armigera* larvae suddenly decreased maintaining the same trend of infestation among the varieties. The mean larval population/plant from pod formation to pod maturity ranges from 0.42 larvae/plant (Pusa 9) to 2.07 larvae/plant (Pusa 2001) and showed significant variation among the varieties. During season II (Table 1), the results revealed that almost the similar trend of infestation by *Helicoverpa* population on different pigeon varieties was found in all the observations as recorded in first season. The mean population of *H. armigera* ranged from 0.28 larvae/plant to 1.73 larvae/plant. The minimum mean population was observed in Pusa 9 (0.28 larvae/plant) followed by Pusa 991, MA6, CORG 9701, Pusa 992, Bahar, BRG 2, ICPL 87, NDA1, UPAS 120, ASHA, Maruti and Pusa 2001.

The pooled data of two years results (Fig. 1) showed a significant variation of larval population of *Helicoverpa armigera* among the varieties of pigeon pea. The results exhibited the minimum infestation level of *H. armigera* in Pusa 9 (0.35 larvae/plant) followed by Pusa 991, MA6, CORG 9701, Pusa 992, Bahar, BRG 2, ICPL 87, NDA1, UPAS 120, ASHA, Maruti and Pusa 2001(1.90 larvae/plant).

Performance of different pigeon pea varieties against Maruca vitrata during two consecutive seasons

The results (Table 2) show that during first week of observation there was no population of *Maruca* larvae in Pusa 9 and Pusa 991 in first season. Maximum population was found in Pusa 2001(1.23 larvae/plant) and no population was found in Pusa 991. In second observation, all the varieties were infested with larvae of *Maruca.* The population of larvae ranged from 0.56 larvae/plant to 2.10 larvae/plant. The lowest population was observed in Pusa 9 (0.56 larvae/plant) followed by Pusa 991, MA 6, CORG 9709, Pusa 992, Bahar, BRG 2, ICPL 87, NDA 1, Upas 120, Asha, Maruti, Pusa 2001. The similar trend of infestation was observed in 3rd, 4th& 5th week observation. The mean of all observations showed that larval population of *M. vitrata* was lower in Pusa 9 (0.89 larvae/plant) and Pusa 991(1.14 larvae/plant) whereas the highest larval infestation was found in Pusa 2001 (4.08 larvae/plant). During second year, there was also significant population occurrence of the target pest was recorded on different varieties. The first week observation showed that similar trend of infestation was found as of previous year. Here also, Pusa 2001 variety recorded the highest larval population (3.40 Larvae/Plant) whereas Pusa 9 & Pusa 991 were free from infestation. The 2nd, 3rd, 4th& 5th week observation revealed almost the same trend of infestation was found as of previous year with minimum pest population in Pusa 9 (0.80, 1.90, 3.60, 4.70 larvae/plant) and Pusa 991 (0.60, 1.20, 4.30, 5.10 larvae/plant) variety and maximum was recorded in Pusa 2001 (6.20, 8.90, 10.40, 11.60 larvae/plant) at various observation, respectively. The mean larval population during 2014-15 represented the same tendency of infestation ranging from 2.20 larvae/plant in Pusa 9 variety to 8.10 larvae/plant in Pusa 2001.

The pooled result (Fig. 1) revealed that during 1st week observation Pusa 9 & Pusa 991 were devoid of any kind of infestation from target pest. During 2nd, 3rd, 4th& 5th week observation both the years Pusa 991 & Pusa 9 recorded minimum larvae/plant and they were statistically at par in those observations. The pooled data showed that the highest infestation was in Pusa 2001 variety (6.09 larvae/plant) followed by Maruti (5.72 larvae/plant), Asha (5.37 larvae/plant),

Table 2. Performance of different pigeon pea varieties against *Maruca vitrata* during two consecutive seasons

Variety	Number of larvae of *Maruca vitrata* (larvae/plant) at different weeks intervals											
	Season I						Season II					
	1st	2nd	3rd	4th	5th	Mean	1st	2nd	3rd	4th	5th	Mean
MA6	0.12 (0.79)	0.84 (1.16)	1.01 (1.23)	1.43 (1.39)	3.31 (1.95)	1.34 (1.36)	0.12 (0.79)	0.90 (1.17)	2.10 (1.59)	5.40 (2.41)	5.60 (2.46)	2.82 (1.82)
Bahar	0.62 (1.06)	1.21 (1.31)	1.58 (1.44)	2.56 (1.75)	5.22 (2.39)	2.24 (1.65)	0.70 (1.09)	2.40 (1.70)	3.90 (2.10)	6.90 (2.72)	7.90 (2.90)	4.36 (2.20)
Asha	1.06 (1.25)	1.92 (1.56)	2.39 (1.70)	3.97 (2.11)	7.92 (2.90)	3.45 (1.99)	2.70 (1.78)	5.80 (2.51)	7.60 (2.84)	9.90 (3.21)	10.40 (3.30)	7.28 (2.79)
Pusa 9	0.00 (0.71)	0.56 (1.02)	0.72 (1.10)	1.04 (1.24)	2.12 (1.62)	0.89 (1.18)	0.00 (0.71)	0.80 (1.13)	1.90 (1.54)	3.60 (2.02)	4.70 (2.28)	2.20 (1.64)
Pusa 2001	1.23 (1.32)	2.10 (1.61)	3.01 (1.87)	4.93 (2.33)	9.14 (3.10)	4.08 (2.14)	3.40 (1.97)	6.20 (2.59)	8.90 (3.06)	10.40 (3.29)	11.60 (3.47)	8.10 (2.93)
Pusa 991	0.00 (0.71)	0.71 (1.10)	0.98 (1.22)	1.22 (1.31)	2.78 (1.81)	1.14 (1.28)	0.00 (0.71)	0.60 (1.05)	1.20 (1.30)	4.30 (2.18)	5.10 (2.36)	2.24 (1.65)
Maruti	1.12 (1.27)	2.08 (1.61)	2.87 (1.83)	4.14 (2.15)	8.39 (2.98)	3.72 (2.05)	3.10 (1.89)	5.90 (2.53)	8.40 (2.98)	10.10 (3.25)	11.10 (3.40)	7.72 (2.87)
ICPL 87	0.93 (1.20)	1.41 (1.38)	1.93 (1.56)	3.02 (1.88)	6.09 (2.57)	2.68 (1.78)	1.39 (1.37)	3.90 (2.10)	5.90 (2.53)	8.10 (2.93)	8.90 (3.07)	5.64 (2.48)
CORG 9701	0.43 (0.96)	0.93 (1.19)	1.13 (1.28)	1.55 (1.43)	3.48 (1.99)	1.50 (1.42)	0.30 (0.89)	1.20 (1.30)	2.40 (1.70)	5.90 (2.52)	6.40 (2.62)	3.24 (1.93)
NDA 1	0.97 (1.21)	1.49 (1.41)	2.11 (1.62)	3.12 (1.90)	7.01 (2.74)	2.94 (1.85)	2.12 (1.62)	4.30 (2.18)	6.70 (2.68)	8.70 (3.03)	9.20 (3.10)	6.20 (2.59)
Pusa 992	0.56 (1.03)	1.02 (1.23)	1.28 (1.33)	2.38 (1.70)	4.73 (2.29)	1.99 (1.58)	0.50 (0.99)	1.90 (1.55)	3.20 (1.92)	6.30 (2.60)	7.80 (2.88)	3.94 (2.11)
BRG 2	0.71 (1.10)	1.32 (1.35)	1.72 (1.49)	2.78 (1.81)	5.81 (2.51)	2.47 (1.72)	1.24 (1.30)	2.80 (1.81)	4.80 (2.30)	7.80 (2.88)	8.40 (2.98)	5.01 (2.35)
Upas 120	1.01 (1.23)	1.78 (1.51)	2.23 (1.65)	3.38 (1.97)	7.34 (2.80)	3.15 (1.91)	2.47 (1.72)	5.10 (2.37)	7.20 (2.77)	9.20 (3.11)	9.70 (3.15)	6.73 (2.69)
SEm±	0.015	0.039	0.049	0.028	0.027	0.013	0.077	0.084	0.094	0.141	0.160	0.067
CD (P≤0.05)	0.043	0.115	0.143	0.082	0.077	0.038	0.226	0.244	0.275	0.413	0.468	0.195

Data in parenthesis are the square root transformed values √ (x+0.5)

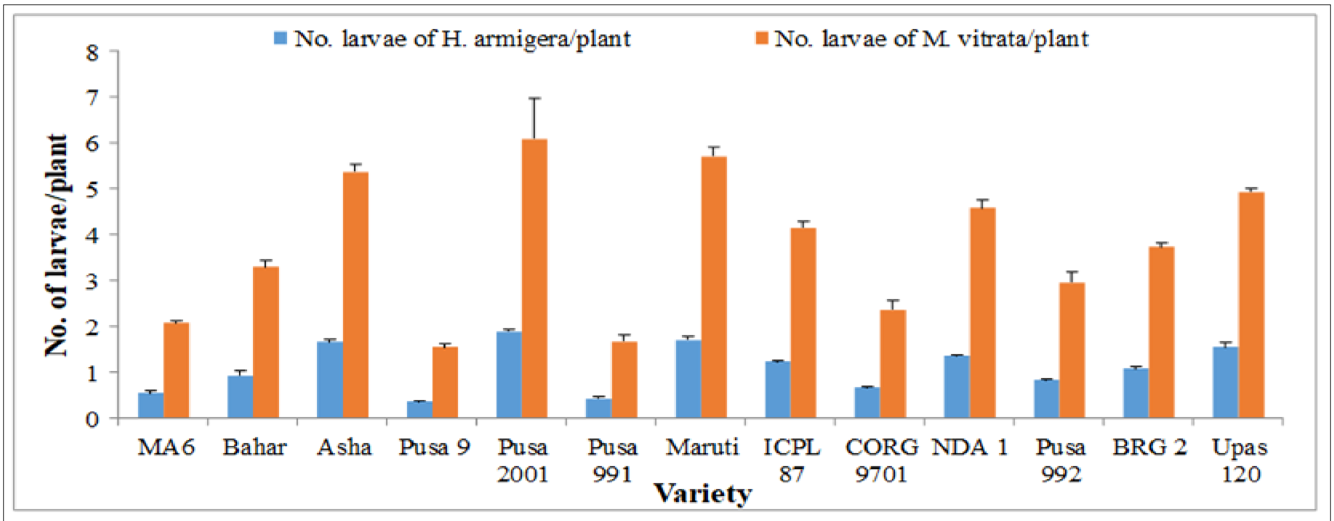

Fig. 1. Pooled larval population of *Helicoverpa armigera* (larvae/pod) and *Maruca vitrata* (larvae/pod) infesting pigeon pea varieties irrespective of pod developmental stages during two seasons.

Upas 120 (4.94 larvae/plant), NDA 1 (4.57 larvae/plant), ICPL 87 (4.16 larvae/plant), BRG 2 (3.74 larvae/plant), Bahar (3.30 larvae/plant), Pusa 992 (2.97 larvae/plant), CORG 9701 (2.37 larvae/plant), MA 6 (2.08 larvae/plant), Pusa 991 (1.69 larvae/ plant) & Pusa 9 (1.54 larvae/plant).

Performance of different pigeon pea varieties against Melanagromyza obtusa (Maggot/pod) during two consecutive seasons

Population of maggot/pod of M. obtusa at different stages of pod development : Number of maggots/pods at different stages of pod development is presented in Table 3. During season I, the least population of maggot recorded in the pods of Pusa 9 variety (0.12 maggot/pod) which was followed by Pusa 991 (0.18 maggot/ pod) having no significant difference among them during pod formation stage. The range of infestation of pod fly was 0.12 maggot/ pod for Pusa 9 to 0.80 maggot/ pod for Pusa 2001. However, the level of infestation was a bit higher at pod formation stage during season II. The mean population showed that minimum infestation recorded in Pusa 9 variety (0.15 maggot/ pod) followed by Pusa 991, CORG 9701, MA 6, Pusa 992, Bahar, ICPL 87, BRG 2, NDA 1, Upas 120, Asha, Maruti, Pusa 2001. The population of *M. obtusa* maggot has increased during pod filling stages of both the years. Though the trend of infestation on different varieties had remained the same as found in pod formation stages. The

Table 3. Performance of different pigeon pea varieties against *Melanagromyza obtusa* (maggot/pod) during two consecutive seasons

Variety	Number of maggots of *M. obtusa* (maggot/pod) at different stages of pod development								
	Pod formation stage			Pod filling stage			Pod maturity stage		
	Season I	Season II	Mean	Season I	Season II	Mean	Season I	Season II	Mean
MA6	0.22 (0.85)	0.32 (0.90)	0.27 (0.88)	0.56 (1.03)	0.76 (1.12)	0.66 (1.07)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Bahar	0.30 (0.89)	0.44 (0.97)	0.37 (0.93)	0.76 (1.12)	1.02 (1.23)	0.89 (1.18)	0.08 (0.76)	0.08 (0.76)	0.08 (0.76)
Asha	0.52 (1.01)	0.76 (1.12)	0.64 (1.06)	1.30 (1.34)	1.76 (1.50)	1.53 (1.42)	0.20 (0.84)	0.24 (0.86)	0.22 (0.85)
Pusa 9	0.12 (0.79)	0.18 (0.82)	0.15 (0.81)	0.30 (0.89)	0.40 (0.95)	0.35 (0.92)	0.00 (0.71)	0.04 (0.73)	0.02 (0.72)
Pusa 2001	0.80 (1.14)	1.16 (1.29)	0.98 (1.21)	2.02 (1.59)	2.72 (1.79)	2.37 (1.69)	0.42 (0.96)	0.48 (0.99)	0.45 (0.97)
Pusa 991	0.18 (0.82)	0.26 (0.87)	0.22 (0.85)	0.46 (0.98)	0.62 (1.06)	0.54 (1.02)	0.00 (0.71)	0.02 (0.72)	0.01 (0.71)
Maruti	0.70 (1.10)	1.02 (1.23)	0.86 (1.16)	1.76 (1.50)	2.38 (1.70)	2.07 (1.60)	0.32 (0.91)	0.28 (0.88)	0.30 (0.89)
ICPL 87	0.32 (0.90)	0.46 (0.98)	0.39 (0.94)	0.80 (1.14)	1.08 (1.26)	0.94 (1.20)	0.10 (0.77)	0.16 (0.81)	0.13 (0.79)
CORG 9701	0.22 (0.85)	0.32 (0.91)	0.27 (0.88)	0.56 (1.03)	0.76 (1.12)	0.66 (1.08)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
NDA 1	0.34 (0.92)	0.50 (1.00)	0.42 (0.96)	0.86 (1.17)	1.16 (1.29)	1.01 (1.23)	0.16 (0.81)	0.12 (0.79)	0.14 (0.80)
Pusa 992	0.26 (0.87)	0.38 (0.94)	0.32 (0.90)	0.64 (1.07)	0.86 (1.17)	0.75 (1.12)	0.04 (0.73)	0.00 (0.71)	0.02 (0.72)
BRG 2	0.32 (0.91)	0.48 (0.99)	0.40 (0.95)	0.82 (1.15)	1.10 (1.26)	0.96 (1.21)	0.08 (0.76)	0.10 (0.77)	0.09 (0.77)
Upas 120	0.40 (0.95)	0.58 (1.04)	0.49 (0.99)	1.04 (1.24)	1.40 (1.38)	1.22 (1.31)	0.18 (0.82)	0.14 (0.80)	0.16 (0.81)
SEm±	0.024	0.018	0.015	0.021	0.026	0.017	0.015	0.017	0.011
CD (P≤0.05)	0.070	0.052	0.043	0.061	0.077	0.048	0.044	0.048	0.032

Data in parenthesis are the square root transformed values √ (x+0.5)

mean data of pod filling stage revealed that the lowest population was found in Pusa 9 variety (0.35 maggot/pod) followed by Pusa 991, MA 6 (0.66 maggot/pod) and CORG 9701 (0.66 maggot/pod) whereas highest infestation was recorded in Pusa 2001 variety (2.37 maggot/pod). During season I, the maggot population/pod of *M. obtusa* in the pod maturity stage showed that no population in Pusa 9, Pusa 991, CORG 9701 & MA 6. The maximum number of maggots had been recorded in Pusa 2001 (0.42 maggots/pod) followed by Maruti, Asha, Upas 120, NDA 1, ICPL 87, Bahar, BRG 2. During season II, there was no population of maggot in CORG 9701 & MA 6 and the least population had been recorded in Pusa 991 (0.02 maggot/pod) which was statistically at par with Pusa 9 (0.04 maggot/pod), Bahar (0.08 maggot/pod) & BRG 2 (0.10 maggot/pod). The mean data revealed that the varieties MA 6 & CORG 9701 had no population of maggot in pod maturity stage whereas Pusa 991 (0.01 maggot/pod) and Pusa 9 (0.02 maggot/pod) recorded the lowest population of maggot. The highest population of maggot was in Pusa 2001 (0.45 maggot/pod).

***Population of pupae/pod of M. obtusa at different stages of pod development* :** The results of population of pupae of *M. obtusa* at different pod developmental stages had been depicted in Table 4 for both the seasons. At pod formation stage of first season, the highest number of pupae was recorded in NDA 1(0.16 pupae/pod) and CORG 9701(0.14 pupae/pod) which was statistically at par. No pupae had been recorded for Pusa 9, MA 6, Bahar and Asha. During season II, there was also no pupae found in MA 6, Bahar and Asha. The mean data showed similar kind of trend of infestation where maximum pupae per pod was recorded in NDA 1 followed by CORG 9701, Upas 120, Pusa 992, ICPL 87, BRG 2 & Maruti.

The population of pupae during pod filling stage of both seasons showed that the population of pupae was increased as compared to pod formation stage of both the years. During season I, Pusa 9 and Pusa 991 both recorded no population of pupa whereas significantly high number of pupae had been observed in Pusa 2001 (0.88 pupae/pod). The same trend had been observed during second season where Pusa 9 and Pusa 991 recorded the lowest population of pupae (0.04 pupae/pod). From the mean data, it was clear that the overall population of pupae was minimum in Pusa 9 (0.02 pupae/pod) and Pusa 991 (0.02 pupae/pod) and the highest was observed in Pusa 2001 (0.90 pupae/pod). At pod maturity stage, the highest number of pupae had encountered in Pusa 2001 (0.96 pupae/pod) and lowest number was in Pusa 9 & Pusa 991 (0.36 pupae/pod) in season I. During season II, maximum population was found in Pusa 2001 (1.74 pupae/ pod) whereas minimum population was recorded for Pusa 9 (0.64 pupae/pod). Mean data showed the same trend of infestation with pupae in all varieties. Pooled of two years data of all developmental stages showed that the lowest number of maggots and pupae/pod was recorded in Pusa 9, Pusa 991 and MA 6 (Fig. 2).

In the present experiment, the results showed that Pusa 9, MA 6, Pusa 991 and CORG 9701were performed better in respect of minimum numbers of larvae of *H. armigera* and *M. vitrata* and a smaller number of maggot and pupae/pod. The literature is very less or scanty regarding varietal evaluation of pigeon pea under new alluvial condition. Therefore, the findings of the present study may be discussed with other related research from other part of country. The good performance of Pusa 9, MA 6, Pusa 991 and CORG 9701against pod borer complex were reported earlier (23). The findings are partially in

Table 4. Performance of different pigeon pea varieties against *Melanagromyza obtusa* (pupae/pod) during two consecutive seasons

Variety	Number of maggots of *M. obtusa* (pupae/pod) at different stages of pod development								
	Pod formation stage			Pod filling stage			Pod maturity stage		
	Season I	Season II	Mean	Season I	Season II	Mean	Season I	Season II	Mean
MA6	0.00	0.00	0.00	0.04	0.06	0.05	0.40	0.70	0.55
	(0.71)	(0.71)	(0.71)	(0.73)	(0.75)	(0.74)	(0.95)	(1.10)	(1.02)
Bahar	0.00	0.00	0.00	0.14	0.22	0.18	0.52	0.94	0.73
	(0.71)	(0.71)	(0.71)	(0.80)	(0.85)	(0.82)	(1.01)	(1.20)	(1.10)
Asha	0.00	0.00	0.00	0.22	0.34	0.28	0.88	1.60	1.24
	(0.71)	(0.71)	(0.71)	(0.85)	(0.92)	(0.88)	(1.17)	(1.45)	(1.31)
Pusa 9	0.00	0.02	0.01	0.00	0.04	0.02	0.36	0.64	0.50
	(0.71)	(0.72)	(0.71)	(0.71)	(0.73)	(0.72)	(0.93)	(1.07)	(1.00)
Pusa 2001	0.02	0.04	0.03	0.88	0.92	0.90	0.96	1.74	1.35
	(0.72)	(0.73)	(0.73)	(1.17)	(1.19)	(1.18)	(1.21)	(1.50)	(1.35)
Pusa 991	0.02	0.04	0.03	0.00	0.04	0.02	0.36	0.66	0.51
	(0.72)	(0.73)	(0.73)	(0.71)	(0.73)	(0.72)	(0.93)	(1.08)	(1.00)
Maruti	0.06	0.12	0.09	0.48	0.76	0.62	0.92	1.62	1.27
	(0.75)	(0.79)	(0.77)	(0.99)	(1.12)	(1.06)	(1.19)	(1.46)	(1.32)
ICPL 87	0.10	0.18	0.14	0.16	0.26	0.21	0.64	1.12	0.88
	(0.77)	(0.82)	(0.80)	(0.81)	(0.87)	(0.84)	(1.07)	(1.27)	(1.17)
CORG 9701	0.14	0.26	0.20	0.06	0.10	0.08	0.40	0.72	0.56
	(0.80)	(0.87)	(0.84)	(0.75)	(0.77)	(0.76)	(0.95)	(1.10)	(1.03)
NDA 1	0.16	0.30	0.23	0.18	0.28	0.23	0.72	1.30	1.01
	(0.81)	(0.89)	(0.85)	(0.82)	(0.88)	(0.85)	(1.10)	(1.34)	(1.22)
Pusa 992	0.12	0.22	0.17	0.08	0.12	0.10	0.52	0.94	0.73
	(0.79)	(0.85)	(0.82)	(0.76)	(0.79)	(0.77)	(1.01)	(1.20)	(1.10)
BRG 2	0.08	0.14	0.11	0.16	0.24	0.20	0.56	1.02	0.79
	(0.76)	(0.80)	(0.78)	(0.81)	(0.86)	(0.84)	(1.03)	(1.23)	(1.13)
Upas 120	0.14	0.26	0.20	0.20	0.32	0.26	0.74	1.34	1.04
	(0.80)	(0.87)	(0.84)	(0.84)	(0.91)	(0.87)	(1.11)	(1.36)	(1.23)
SEm±	0.013	0.018	0.011	0.011	0.023	0.013	0. 014	0.016	0.011
CD (P≤0.05)	0.039	0.054	0.032	0.032	0.067	0.036	0.042	0.046	0.030

Data in parenthesis are the square root transformed values √ (x+0.5)

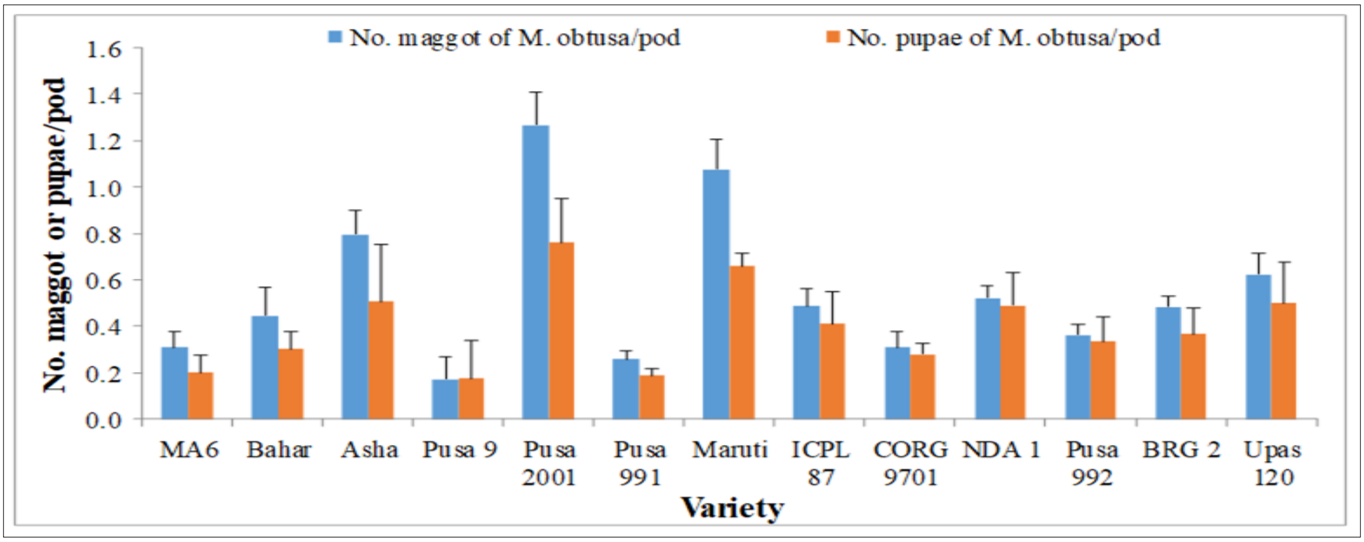

Fig. 2. Pooled population of *Melanagromyza obtusa* (maggot/pod and pupae/pod) infesting pigeon pea varieties irrespective of pod developmental stages during two seasons.

agreement with earlier researchers (24) who reported that CORG13 recorded minimum loss of yield due to pod borer complex among the 42 pigeon pea varieties evaluated during kharif season. The present results may be augmented with the findings of many workers (25, 26, 27) who screened pigeon pea varieties against pod borer complex. The results may be corroborated with the findings of previous authors (28) who reported that ICPL-83015 and Pusa-6 were relatively less susceptible against pod borers in pigeon pea. The findings of the present experiments are in similar line with other workers (29) who revealed that minimum pod damage due to *H. armigera* and *M. obtusa* was found in MA 6 and maximum was in Bahar. It is reported that the highest pod damage due to pod borers in pigeon pea were MAL-31, MAL-32 and Bahar (30).

Conclusion

The results of the present study revealed that MA 6, Pusa 9, Pusa 991 and CORG 9701 recorded a smaller number of larval populations of *H. armigera* and *M. vitrata* and as well as lower number of maggot and pupae of *M. obtusa* in all the developmental stages of pod during two consecutive years under new alluvial zone of eastern India. The present study identified some promising varieties against major pod borer complex of pigeon pea. Therefore, it may be concluded that these varieties may be useful for future breeding programme as well as these varieties can be incorporated for successful implementation of integrated management programme of borer pests in pigeon pea.

Acknowledgements

First author is dully acknowledged to the DST, Ministry of Science and Technology, Government of India to help for conducting this research through Inspire Fellowship and authors duly acknowledge to the Indian Institute of Pulses Research, Kanpur, India for providing pigeon pea varieties to carry out this experiment.

Authors' contributions

BCD, PD and AS conceptualized the study and conducted the research. SP and SS were associated with the manuscript writing. CS conducted the statistical tests. SP and SP edited the manuscript. NKA conducted the plagiarism check and editing of manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

References

1. Badvel A, Vadivel N, Sivakumar R, Natarajan S, Arunadevi K. Optimizing land configuration and weed management practices for enhanced productivity of pigeon pea. Plant Science Today.2024;11(sp4):1-10. https://doi.org/10.14719/pst.5468
2. Saxena KB, Kumar RV, Sultana R. Quality nutrition through pigeon pea - A review. Health. 2010; 2: 1335-44.
3. DES, MoAF & W. fourth advanced estimates. 2022. https://pib.gov.in/PressReleasePage.aspx?PRID=1852470
4. Tridge, 2023, https://www.tridge.com/intelligences/pigeon-pea/IN
5. India stat 2021-22, https://www.indiastat.com/data/agriculture/arhar-tur-pigeon-pea-586579.
6. Lal SS. Host plant resistance in pigeon pea against the pod fly, *Melonagromyza obtusa* Malloch. Indian Journal of Pulses Research.1998;11:1-14.
7. Karmakar K, Patra, S. Bio-efficacy of some new insecticide molecules against pod borer complex of red gram. Legume Research. 2015;38(2):253-59. https://doi.org/10.5958/0976-0571.2015.00061.2
8. Das BC, Patra S, Dhote VW, Alam SKF, Chatterjee ML, Samanta A. Mix Formulations: An alternative option for management of gram pod borer, *Helicoverpa armigera* H. and pod fly, *Melanagromyza obtusa* M. in pigeon pea. Legume Research. 2015;38(3):396-401. https://doi.org/10.5958/0976-0571.2015.00124.1
9. Das BC, Patra S, Samanta A, Dhar PP. Evaluation of biorational insecticides and bio-pesticides against pod borer complex in pigeon pea. International Journal of Bio-resource and Stress Management. 2022;13(3):261-67. https://doi.org/10.23910/1.2022.2620b
10. Lateef SS, Reed, W. Review of crop losses caused by insect pests of the pigeon pea internationally and in India. Indian Journal of Entomology (Spl. Issue). 1983;2:284-91.
11. Patra S, Firake DM, Azad Thakur NS, Roy A. Insect pest complex and crop losses in pigeon pea in medium altitude hill of Meghalaya. The Bioscan. 2016;11(1) (Supplement on Agronomy):297-300.
12. Lal SS, Yadava CP, Sachan JN. Assessment of pod borer damage on pigeonpea in different agro ecological zones of Uttar Pradesh. Indian Journal of Pulses Research. 1993;5:174-78.
13. Durairaj C. Ecology and management of tur pod fly, *Melanagromyza obtusa* Malloch in pigeonpea. Ph. D. Thesis, Tamil Nadu Agricultural University, Coimbatore, India 1995.
14. Patnaik HP, Samolo AP, Samolo BN. Susceptibility of some early varieties of pigeonpea for pod borers under protected conditions. Legume Research. 1986;9:7-10.
15. Dharmasena CMD, Subasinghe SMC, Lateef SS, Menike S, Saxena KB. Ariyaratne HP. Entomology research. In Pigeonpea Varietal Adaptation and Production Studies in Sri Lanka. Report of Work. Department of Agriculture, Sri Lanka. International Crops Research 224 Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, 1992;104-08.
16. Srivastava CP, Nitin J. Insect pest management in pigeon pea in Indian scenario: A critical review. Indian Journal of Entomology. 2011;73 (1):63-75.
17. Thilagam P, Gopikrishnan A. Integrated Pest management module against pod borer complex in pigeon pea (*Cajanus cajan* L.). Journal Krishi Vigyan. 2020;9(1):180-83. https://doi.org/10.5958/2349-4433.2020.00162.2
18. Vijayakumari N, Shanthi M, Anusha N, Murugan M, Paripoorani S, Varanavasiappan et al. Relative toxicity of subspecies of *Bacillus thuringiensis* kurstaki HD-1 and HD-73 against the larvae of legume pod borer, *Maruca vitrata*, F. (Lepidoptera: Crambidae). Plant Science Today. 2025;12(1):1-5. https://doi.org/10.14719/pst.6035
19. Yadav DK, Sachan SK, Singh G. Singh DV. Insect pests associated with pigeonpea variety upas 120 in western Uttar Pradesh, India. Plant Archives. 2016;16(1):140-42.
20. Sharma HC. Host plant resistance to insect pests in pigeon pea: Potential and limitations. Legume Perspectives. 2016;11:24-29.
21. Sachan JN. Present status of *Helicoverpa armigera* in pulses and strategies for its management. In: Proceedings of first national workshop on *Helicoverpa* management. Current status and future strategies, Kanpur, 30-31 August, 1990. Kanpur, Indian Institute of Pulses Research, 1992. p. 7-23.
22. Gomez KA, Gomez AA. Statistical procedures for agricultural research. 1984; John Wiley & Sons.
23. Das BC, Patra S, Sarkar S, Pramanik S, Dhar PP, Samanta A. Impacts of varieties and their biochemical parameters on pod damage by borer complex in pigeon pea in eastern India. AMA, Agricultural Mechanization in Asia, Africa and Latin America. 2024; 51(1):17073-86.
24. Raut SB, Nawale RN. Mote UN. Field screening of pigeon pea germplasm against pod borer complex. Agricultural Science Digest Karnal. 1993;13(1):17-19.
25. Sahoo BK, Senapati B. Relative abundance of pod borer species in different maturing pigeon pea varieties in Coastal Belt of Orissa. Indian Journal of Plant Protection. 2000;28(2):192-94.
26. Kumar R, Keval R, Yadav A. Srivastava CP. Field screening and evaluation of long duration pigeonpea genotypes against the infestation of pod fly (*Melanagromyza obtusa* Malloch). The Ecoscan. 2015;VII (Special issue):291-95.
27. Khan NA, Kumar BP, Husain R, Gyanendra K, Kaushal A, Prasad S, Singh N. Singh KN. Screening of Different Pigeon pea (*Cajanus cajan L. Millspough*) varieties against pod borer (*H. armigera*) resistance. International Journal of Current Microbiology and Applied Sciences. 2018; Special Issue-7: 224-29.
28. Akhauri RK, Sinha MM. Yadav RP. Evaluation of some early pigeon pea genotypes for their susceptibility against pod borers under field conditions of North Bihar. Journal of Entomological Research. 2001;25 (4):315-28.
29. Prasad R, Singh PP. Extent of Pod Damage by Pod Borer and Pod Fly in Different Genotypes of Pigeonpea. Trends in Biosciences. 2017;10(27):5788-89.
30. Kumar R, Keval R, Yadav A. Determination of damage caused by major insect pest in long duration pigeonpea genotypes. Research in Environment and Life Sciences. 2016;9(5):526-27.