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Screening of pigeonpea [*Cajanus cajan* (L.) Millsp.] Against Tur Pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae) in long duration pigeonpea genotypes

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Abstract
The pigeonpea was infested with the number of insect pests at various stage of crop growth. Out of which the incidence pattern of *C. gibbosa* was studied. The result of the investigation pertaining to the "Screening of pigeonpea [*Cajanus cajan* (L.) Millsp.] against Tur Pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae) in long duration Pigeonpea genotypes" was carried out in 2018-19 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. This insect was studied during reproductive phase of the crop during 2018-19. The very first presence of pod fly, Some insect populations were observed during the crop's reproductive period. Pod Fly's First Incidence, *M. obtusa* was observed in all genotypes during the 4th standard week of 2018-19. The various peak of the pod fly population was reported in different genotypes from the 6th standard week to the 11th standard week. The peak population of maggots was observed in the 11th standard week in the genotype MAL- 13 (AVT1), AVT1-704, AVT1-706 and AVT1-709 with population of (2.61 maggots/plant), (2.42 maggots/plant) and (2.40 maggots/plant), respectively. Pod fly's *M. obtusa* the damage ranged from 27.33 per cent in the genotype AVT2-904 to 51.00 per cent in cultivar AVT1-703 among all genotypes screened by the genotype. The percentage of grain damage caused by pod fly damage ranged from 12.68% in genotype AVT2-904 to 30.52% in genotype AVT2-907 Highest grain damage was recorded in genotype. In AVT1-704 the cereal yield of different genotypes was from 617kg / ha to 1434kg / ha with AVT1-708 genotype.

Keywords: pigeon pea, pod bug, screening, damage, genotype, *M. obtuse*

Introduction
Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is the largest plant of tropical and subtropical climate grains cultivated in 22 Asian, African and Caribbean nations, covering nearly 4.8million hectares. India has a virtual monopoly of 90 percent of the world's total production of pigeon pea. In India, this covers a surface of 3.88 million acres for a production area of 3.17 million tons (E-Pulses IIPR, 2015-16). It is usually grown and intertwined with other pulses in marginal lands. But as only crops get cash crops, farmers cultivate pigeonpea.
Pigeonpea is a short-lived continuous shrub grown in tropical and subtropical zones as custom as grain-legum crop. Pigeonpea is a production of pigeons in grain legumes every year. It is called Red grams and is mainly cultivated as food (Red) or Congo (English), Tur, and Archar (Hindi). The cooking of different plates is based on dry whole seed, split seed (dhal) and dehulled seed. The plants also cultivate ingredients like drillings, fuel, stomach, basket making, etc., in addition to their use as a foodstuff.
Pigeonpea has a deep root system which allows them to resist droughts and to tie the soil and reducing soil erosion in mountain slopes. Pigeonpea is poorly cultivated due to its deep rain systems and is consequently widely utilized in inter-cropping systems with cereals, such as millets, sorghum and maize. Pigeonpea slowly grows and does not interfere with accompanying crops throughout the early vegetative phase. The plants are caught below. After harvesting the accompanying crop, pigeons continue to grow and can fill the land with the look of a single crop (AICRP).
The cultivation process uses plants to fix approximately 40kg/ha of atmospheric nitrogen and to add valuable organic matter in the soil by falling leaves (up to 3.1t/ha of the dry matter leaf).

The roots of the soil contribute to the development of phosphorus. More than 21 percent of pigeon seed protein is well compared to that of other significant grain legumes. Due to its many unique characteristics and benefits, Pigeonpea has become ideal for sustainable agriculture systems in rainfed areas.. Given that the ripeness of the palomarine variation is large (90-300 days) the four main time durations are: extra short (mature within < 100 days), short (100-120 days), medium (140-180 days) and long (100-120 days) (200-280 days). The growing community is appropriate for a certain agro-ecosystem that can be identified by height, temperature, latitude and daytime. The traditional pigeon-pea and land races are always long lasting and have been grown with other cereals and legumes of earlier ages. The 182 genetic and genomic resources of grain legume improvements in Asia in rice-what systems in the indo-gangetic field, in special for periods of water shortage, soil fertility price and incentives, can be included as an alternative to rice as extra short varieties. The typical pigeon pea genotypes are large and mature in six to 12 months (up to 2 m high). In general, these plants are too large and dense for safe and effective application of insecticides. In the past few years many short-term genotypes (less than 1 m), short-term, have been developed and released (mature in less than 100 days These genotypes are generally productive as monocrops of high densities, than an intercropped system. The genotype and cultivation system selection influences the pest's composition and density.

Much effort was made in identifying and integrating these resistances in agricultural crops, in particular *Helicoverpa* (Hubner) and *Melanagromyza obtusa*, to identify the resources to resist the most significant insect pests (Malloch).

Without adequate technological progress, quite rightly proposed the idea that production technology in agriculture and hence manufacture technology cannot achieve success in agriculture.

In India the productivity of pigeonpea hasn't increased significantly over the past decade. One of the main reasons for low productivity is due to insect pest damage. Nearly 90% of the crops are cultivated in rainfed conditions with medium or long-term cultivars. Short term varieties are suitable for irrigated environments. Since colonial pigeons are grown under a number of agroclimate conditions and crops, Sachan *et al*. (1994) [13] pigeon pests are vulnerable to a number of pests, although they cause relatively few severe losses, and almost 250 of the world's low yields in eight groups and 61 families. Other major pests such as pesticides and occasionally significant decreases in grain production for long-term pork. Gram pod borer Hubner, tur puede fly *Melanagromysa obtusa* Powder pillar includes (Malloch). The principal and important plagues, however, are floral pests and can borers, are not economic damage to early or vegetative phases. Pod fly The pigeon pea pest in Asia *Melanagromyza obtusa* is a large and large palms pea. It nurtures pigeon pea and related species, and offers a small range of host. From this hole emerge the completely cultivated larvae in the pod walls. The window of this hole allows the adult to leave the hole.

In the north-west area, there have been 29.7% damages, 13.2% damage in the north zone 24.3% damage and 36.4% injury in the soouth region (lateef & reed) in the north-west region. The results of the study were 22.5% damage in the north part of India and 13.2% damage in the south of India. The results were*: Melanagromyza obtusa* in a survey by ICRISAT (malloch). The annual pigeonpea crop was projected to lose 25 to 30 percent in U.P. (Lal and Yadav, 1987) [12]. Besides the podfly and other insects,

Materials and Methods

The field experiment was conducted on the topic "Screening of pigeonpea [*Cajanus cajan* (L.) Millsp.] against Tur Pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae) in long duration Pigeonpea genotypes" The present investigation on the cooperative output of certain genotypes was conducted during 2018-19 at Agriculture Research Farm, Institute of Agricultural Science, Banaras Hindu University, Varanasi.

Seed sowing was done manually with spacing from row to row (75 cm), and spacing from plant to plant (25 cm).In the first 10 accessions, the field experiment was performed with 18 pigeon pea accession into a separate trial and in the second trial 8 accession was used respectively as an initial varietal trial and advanced varietal trial.

The following 18 genotypes/varieties have been screened against infestation of pigeon pea pod pest complex.

AVT-1	**AVT-2**
AVT1-701	AVT2-901
AVT1-702	AVT2-902
AVT1-703	AVT2-903
AVT1-704	AVT2-904
AVT1-705	AVT2-905
AVT1-706	AVT2-906
AVT1-707	AVT2-907
AVT1-708	MAL-13 (Check)
AVT1-709	
MAL-13 (Check)	

Details of Experiment

1. Design : Randomized block design
2. Number of replication : 3
3. Treatments : 18
4. Total no. of plots : 54
5. Plot size : 4m x 3.75m=15 m^2
6. Row to Row and plant to plant spacing : 75 cm x 25cm

For the assessment of pod fly *M. obtusa* the seeds which become shrivelled with dark patches can be set as criteria for this, sucking pest|

Tur Pod fly, *M. obtusa* (Malloch)

This insect is important in Central and Northern India, where it causes severe losses to varieties that mature medium to long. The eggs are laid in 10-35-day-old pod lumen.

Maggots are tiny in colour 3-10 day incubation time. The white legless larvae feed through tunneling inside the green seeds. The larval period lasts 6-19 days, and the larval period has 3 instars. The fully mature maggots chew tunnels in the pod wall before pupation leaves a preserved "window" of a paper membrane through which flights appear in a pod after pupation. Adults are diminutive black flying colours. The pupal period lasts 8-31 days. Dry pods showing a hole in the pin head. Seeds are shrivelled, stripped and partially eaten, and the seeds that have been damaged are not fit for human consumption and sowing.

$$\% \text{ Pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

$$\% \text{ Grain damage} = \frac{\text{Number of damaged grains}}{\text{Total number of grains}} \times 100$$

$$\% \text{ Grain damage} = \frac{\text{Number of damaged grains}}{\text{Total number of grains}} \times 100$$

Grain yield: When the crop matured, separately threshed and grain yield per plot was recorded and transformed to grain yields in kg / ha, each genotype was individually harvested.

Statistical analysis: All data recorded have been statistically calculated according to the Randomized Block design method and population data from the insects have been transformed using a transformable square root method, and harm evaluation data have been transformed using the transformed method sin (q= sin-1x).

Results and Discussion

The study of damage assessment in relation to per cent pod and grain damage caused by pod fly in 2018-19 has examined 18 pigeonpea genotypes under unprotected conditions. The results of the research and the corresponding discussion were summarized under the following headings:

Experimental findings

The present investigation entitled "Screening of pigeonpea [*Cajanus cajan* (L.) Millsp.] against Tur Pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae) in long duration Pigeonpea genotypes" were performed during 2018-19 at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Observations were recorded at weekly intervals on the occurrence of insect pest species on eighteen pigeonpea genotypes against tur pod fly *[Melanagromyza. obtusa* (Malloch)]. The result obtained from the investigation have been summarized under the following heads.

Tur Pod fly, *M. obtusa* (Malloch)

The first occurrence of pod fly *M. obtusa* was observed in all genotypes in the 4th standard week during 2018-19 and significantly differed in all genotypes with a peak population of (0.43 maggots / plant) in the MAL-13 (check) genotype followed by AVT1-705 (0.42 maggot / plant), AVT2-901 (0.42 maggots / plant) in the first week. The pod fly population has persisted in all genotypes from 4th Standard Week to 12th Standard Week 2018-2019. In the sixth standard week to the 11th standard week, different populations of podfly peaks were reported in different genotypes. In 11th standard weeks the peak maggot population with (2.61 maggot/plant), (2.42 maggot/plant), (2.40 maggot/plant) and (2.24 maggot/plant) was observed in the MAL-13 genotype follows by AVT1-704, AVT1-706 and AVT1-709. The lowest Maggot population was observed with (1.13 maggots/plant) and (1.26 maggots/plant) during 11th standard week in AVT2-907 and AVT1-703 genotype respectively table No.1.1 and 1.2.

The pooled mean population of maggot also different statistically in all the genotypes with the highest population in genotype MAL13 (AVT1) (1.40 maggots/plant) followed by AVT1-704 (1.13 maggots/plant), AVT1-706 (1.05 maggots/plant), AVT1-709 (0.93 maggot/plant), AVT1-701 (0.85maggots/ plant), AVT2-901 (0.83 maggots /plant) and AVT2-903 (0.75 maggots/plant) and AVT2-902 (0.74 maggots/plant)and AVT1-702(0.72 maggots/plant) AVT1-708 (0.71 maggots /plant) AVT2-905 & AVT2-906 (0.71 maggots /plant) AVT2-907 (0.63 maggots /plant) AVT1-703 (0.61 maggots /plant).The genotype AVT1-707 recorded lowest population *i.e* (0.57 maggots/plant), closely followed by MAL 13 (AVT2) (0.60 maggots/plant) table No. 1.1 and 1.2.

Extent of damage done by major insect pests in certain long-duration pigeonpea genotypes

Pod damage

During 2018-19, the proportion of pod damage caused by pod fly was substantially different on different genotype pigeonpea. Its degree of damage in cultivar AVT2-904 ranged from 27.33% to 51.00% in cultivar AVT1-703. The AVT2-907, AVT1-707, AVT1-702, AVT2-902, AVT2-901, AVT1-704, AVT2-906, AVT2-903, AVT1-709, AVT1-705, AVT1-701, AVT2-905, MAL-13 (AVT-1), AVT1-708, MAL- 13 (AVT-2), and AVT1-706 genotypes. Shows comparatively fewer pod damage of (49.67 percent), (47.33 percent), (47.00 percent), (45.67 percent), (45.33 percent), (44.33 percent), (42.33 percent), (37.33 percent), (36.00 percent), (35.67 percent), (34.33 percent), (33.67 percent), (32.33 percent), (31.67 percent) compared to AVT1-703 (51.00 percent), respectively table No. 2.1 and 2.2.

Grain damage

The proportion of grain damage from pod fly in different genotypes of pigeonpea during 2018-2019 was significantly different. The loss in genotype AVT2-904 ranged from 12.68% to 30.52% in genotype AVT2-907. Highest grain damage was recorded in genotype followed by AVT1-703 (29.21), AVT1-702 (26.68), AVT2-901 (26.62), AVT1-707 (23.46), AVT2-906 (23.32), AVT2-902 (23.16) MAL-13(AVT1) (22.28), AVT1-708(21.31), AVT1-709 (21.30), AVT1-704 (20.63), AVT2-903 (18.73), AVT1-701 (17.99), AVT2-905 (17.97), MAL 13(AVT2) (16.41), AVT1-706 (15.33), percent. Lowest grain damage occurred in genotype AVT2-904 (12.68%) followed by AVT1-705 (13.92%) table No. 2.1 and 2.2.

To determine the grain yield of pigeonpea genotypes of a certain long duration

The data presented in Table No. 2.1 and 2.2. displays the grain yield of the various genotypes of pigeon pea in grain yields. The genotype AVT1-704 is 617kg / ha to 1434kg / ha throughout the AVT1-707 genotype. The genotypes AVT1-708and AVT1-706 and AVT1-709 & AVT2-901, AVT2-907, MAL- 13 (AVT2), AVT1-702 & AVT1-705, AVT1-703, AVT2-902, AVT2-906, AVT2-903, AVT2-905, AVT2-904 and MAL 13(AVT1) show comparatively higher yields, *i.e.*, 1433 kg/ha, 1025 kg/ha, 1017 kg/ha, 1000 kg/ha, 900kg/ha, 850kg/ha, 840kg/ha, 767kg/ha, 748kg/ha, 717kg/ha and 667kg/ha respectively as compared to AVT1-708 giving yield 1233kg/ha.

Table 1: Pod fly population [*M. obtusa* (Malloch)] on certain genotypes of long duration pigeonpea during *Kharif* 2018-19:

Pod fly maggot per plant										
Genotypes	4th SW	5th SW	6th SW	7th SW	8th SW	9th SW	10th SW	11th SW	12th SW	Average
AVT1-701	0.32(1.149)	0.92(1.386)	0.41(1.187)	0.95(1.396)	0.53(1.237)	0.65(1.285)	0.85(1.360)	1.7(1.643)	1.3(1.517)	0.85
AVT1-702	0.23(1.109)	0.87(1.367)	0.15(1.072)	0.81(1.345)	0.47(1.212)	0.53(1.237)	0.77(1.330)	1.47(1.572)	1.15(1.466)	0.72
AVT1-703	0.12(1.058)	0.76(1.327)	0.25(1.118)	0.85(1.360)	0.31(1.145)	0.35(1.162)	0.67(1.292)	1.26(1.503)	0.92(1.386)	0.61
AVT1-704	0.39(1.179)	0.95(1.396)	0.51(1.229)	1.1(1.449)	0.67(1.292)	0.92(1.386)	1.64(1.625)	2.42(1.849)	1.54(1.594)	1.13
AVT1-705	0.42(1.191)	0.97(1.404)	0.36(1.166)	0.91(1.382)	0.5(1.225)	0.61(1.269)	0.7(1.303)	1.7(1.643)	1.28(1.510)	0.83
AVT1-706	0.33(1.153)	0.89(1.375)	0.48(1.217)	0.97(1.404)	0.68(1.296)	0.9(1.378)	1.43(1.559)	2.4(1.844)	1.4(1.549)	1.05
AVT1-707	0.13(1.063)	0.8(1.342)	0.04(1.020)	0.74(1.319)	0.37(1.170)	0.27(1.127)	0.48(1.217)	1.02(1.421)	1.27(1.507)	0.57
AVT1-708	0.23(1.109)	0.86(1.364)	0.06(1.030)	0.77(1.330)	0.48(1.217)	0.31(1.145)	0.78(1.334)	1.52(1.587)	1.4(1.549)	0.71
AVT1-709	0.35(1.162)	0.95(1.396)	0.46(1.208)	0.97(1.404)	0.6(1.265)	0.78(1.334)	1.14(1.463)	2.24(1.800)	0.9(1.378)	0.93
MAL 13	0.43(1.196)	0.96(1.400)	0.58(1.257)	1.02(1.421)	0.73(1.315)	0.97(1.404)	1.7(1.643)	2.61(1.900)	1.22(1.490)	1.4
SE(m)±	0.01	0.004	0.004	0.008	0.003	0.003	0.009	0.008	0.009	
CD at 5%	0.031	0.012	0.013	0.023	0.008	0.008	0.026	0.024	0.027	

Figures in parenthesis are Arc Sine Percentage transformed values.

Table 1.1: Pod fly population [*M. obtusa* (Malloch)] on certain genotypes of long duration pigeonpea during *Kharif* 2018-19:

Pod fly maggot per plant										
Genotypes	4th SW	5th SW	6th SW	7th SW	8th SW	9th SW	10th SW	11th SW	12th SW	Average
AVT2-901	.42(1.192)	.94(1.393)	.25(1.118)	.87(1.367)	.3(1.140)	.62(1.273)	.82(1.349)	1.82(1.679)	1.43(1.559)	0.83
AVT2-902	.34(1.158)	.91(1.382)	.35(1.162)	.93(1.389)	.46(1.208)	.26(1.122)	.79(1.338)	1.4(1.549)	1.22(1.490)	0.74
AVT2-903	.4(1.183)	.88(1.371)	.13(1.063)	.8(1.342)	.57(1.253)	.38(1.175)	.34(1.158)	2.15(1.775)	1.1(1.449)	0.75
AVT2-904	.27(1.127)	.72(1.311)	.21(1.100)	.86(1.364)	.5(1.224)	.41(1.213)	.6(1.264)	1.31(1.520)	.93(1.389)	0.65
AVT2-905	.03(1.015)	.74(1.319)	.54(1.241)	1.04(1.428)	.19(1.091)	.4(1.183)	.77(1.330)	1.45(1.565)	1.19(1.480)	0.71
AVT2-906	.37(1.170)	.95(1.396)	.15(1.072)	.82(1.349)	.32(1.149)	.53(1.237)	.72(1.311)	1.45(1.565)	1.04(1.428)	0.71
AVT2-907	.32(1.149)	.92(1.386)	.18(1.086)	.83(1.353)	.42(1.192)	.37(1.170)	.57(1.253)	1.13(1.459)	.92(1.386)	0.63
MAL 13	.1(1.049)	.72(1.311)	.4(1.183)	.9(1.378)	.38(1.175)	.49(1.221)	.74(1.319)	1.39(1.546)	1.03(1.425)	0.6
SE(m)±	0.008	0.002	0.009	0.002	0.008	0.008	0.009	0.007	0.007	
CD at 5%	0.026	0.005	0.028	0.005	0.025	0.026	0.027	0.021	0.021	

Figures in parenthesis are Arc Sine Percentage transformed values.

Table 2.1: Extent of damage caused by pod fly in pigeonpea genotypes during *Kharif* 2018-19

Name of the Entry	% Damage by tur pod fly		Yield
	Pod	Grain	
AVT 1 -701	35.67 (36.64)	17.99 (25.04)	777
AVT 1 -702	47.00 (43.24)	26.68 (31.03)	1000
AVT 1 -703	51.00 (45.55)	29.21 (32.65)	900
AVT 1 -704	44.33 (41.72)	20.63 (26.98)	617
AVT 1 -705	36.00 (36.84)	13.92 (21.86)	1000
AVT 1 -706	31.67 (34.19)	15.33 (22.94)	1233

AVT 1 -707	47.33 (43.44)	23.46 (28.90)	1433
AVT 1 -708	33.67 (35.44)	21.31 (27.48)	1233
AVT 1 -709	37.00 (37.44)	21.30 (27.45)	1233
MAL- 13 (check)	34.33 (35.77)	22.28 (28.11)	667
SE(m)±	1.954	1.349	1.210
CD at p = 0.05%	5.851	4.040	3.622

Figures in parenthesis are Arc Sine Percentage transformed values.

Table 2.2: Extent of damage caused by pod fly in pigeonpea genotypes during *Kharif* 2018-19

Name of the Entry	% Damage by podfly		Grain Yield (Kg/ha)
	Pod	Grain	
AVT 2 - 901	45.33 (42.30)	25.62 (30.39)	1233
AVT 2 - 902	45.67 (42.47)	23.16 (28.67)	850
AVT 2 - 903	37.33 (37.64)	18.73 (25.62)	767
AVT 2 - 904	27.33 (31.49)	12.68 (20.84)	717
AVT 2- 905	35.67 (36.63)	17.97 (24.99)	748
AVT 2- 906	42.33 (40.56)	23.32 (28.80)	840
AVT 2 - 907	49.67 (44.79)	30.52 (33.45)	1025
MAL-13 (Check)	32.33 (34.61)	16.41 (23.86)	1017
SE(m)±	1.914	1.440	1.729
CD at p = 0.05%	5.860	4.411	5.296

Figures in parenthesis are Arc Sine Percentage transformed values.

Result and Discussion

In order to determine the population of major insect pests on different genotypes of pigeon pea and risk analysis of percent pod and grain damage by pod pest complex, eighteen genotypes have been risen under unsupervised situations. Performance in yield (kg/ha) was also reported at crop harvest. is a pigeon pest cardinal insect in this zone and is increasing as the crop age increases. Current damage to the economic product also occurs in cases of pulses following flowering. The AVT1-707 was shown to be the most resistant to pod fly damage among the 18 geneotypes screened. For successful pod bug control, this genotype can therefore be recommended for Varanasi farmers.

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