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Identification of pigeonpea superior genotypes against infestation of pod fly, *Melanagromyza obtusa* (Malloch) (Diptera: Agromyzidae)

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Abstract

A field experiment was conducted to evaluate 20 pigeonpea accessions to identify superior pigeonpea genotypes against pod fly, *Melanagromyza obtusa* (Malloch) infestation at Agricultural Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani), Maharashtra, India during *Kharif* season of 2015-2016. The pod and grain damage due to *M. obtusa* was ranged from 1.33 to 100.00 and 0.71 to 91.53 per cent. The pod and grain damage was significantly lowest in *Cajanus scarabaeoides* (no damage), *Cajanus cajanifolius* (3.75 and 1.07 per cent), V-127 (9.16 and 3.82 per cent), BDN-2010-1 (15.67 and 8.46 per cent), BSR-1 (16.53 and 9.36 per cent) and ICP-10531 (29.35 and 14.83 per cent) with at par reaction, indicating their high level of resistance against *M. obtusa*. Whereas the genotypes, KALI TUR (32.49 and 21.10 per cent), BDN-2013-41 (42.90 and 23.10 per cent), BDN-2014-3 (43.98 and 19.68 per cent), GULYAL (44.45 and 31.88 per cent), BDN-2014-1 (52.12 and 34.43 per cent), LRG-41 (53.29 and 43.65 per cent), BSMR-736 (55.18 and 29.84 per cent), BDN-2 (58.86 and 36.06 per cent) and ICPL-322 (60.18 and 32.62 per cent) shown moderate pod and grain damage levels and having at par effect with each other. The genotypes, BRG-2 (89.75 and 82.02 per cent) recorded highest pod and grain damage due to *M. obtusa* and was at par with BRG-1 (77.65 and 71.53 per cent), ICP-7035 (70.98 and 65.14 per cent), BSMR-846 (64.59 and 51.20 per cent) and KHADKI (62.80 and 43.72 per cent), respectively, indicated their high level of susceptibility against *M. obtusa*. However the genotype *Cajanus scarabaeoides* shown no pod and grain damage due to *M. obtusa*, indicating that the genotype is having most resistance against *M. obtusa* infestation and it can be used in breeding programmes in order to produce resistant cultivars for the benefit of farmers.

Keywords: damage, genotypes, infestation, *Melanagromyza obtusa*, pigeonpea and pod fly

1. Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) is grown throughout the tropics, but most widely in south and southeast Asia, where it is preferred source of vegetable protein. It is one of the major grain legumes in the semi-arid tropics (Nene and Sheila, 1990) [1]. Pigeonpea yields have remained stagnant for the past three to four decades, largely due to insect pests' damage. More than 200 species of insects feed on this crop, of which pod fly, *Melanagromyza obtusa* (Malloch) is an important pest, in addition to *Helicoverpa armigera* (Hubner) (Lateef and Reed, 1990; Shanower *et al*., 1999; Kumar and Nath, 2003; Kumar *et al.*, 2003; Nath *et al*., 2008) [2, 3, 4, 5, 6]. The oviposition of pod fly takes place on the inner surface of the pod walls and after hatching the larvae mines into the pods and feeds on the soft seed thus making it unfit for human consumption as well as seed purpose (Lal and Yadav, 1993) [7]. Losses due to pod fly damage have been estimated to be US$ 256 millions annually (Sharma *et al*., 2011) [8]. More than 10,000 germplasm accessions have been screened for pod fly resistance (Lateef and Pimbert, 1990) [9]. Many researchers in India have identified different lines such as PDA88-2E, PDA89-2E, IC245312, IC468105, IC489744, IC490149, IC490388, IC525402, ICPL11964, ICP1053, PDA 89-2E, PDA 882-E, PDA 91-1E, PDA 92-2E, PDA 93-2E, ICPL 82064-E15-E1, Phule T25, T32, KP 4769, C-11 and BDN-1 to provide moderate resistance to the pigeonpea pod fly (Singh *et al*., 2013) [10]. However, Singh and Singh (1990) [11] reported that no definite conclusions could be drawn about the relative susceptibility of pigeonpea genotypes to pod fly damage because of staggered flowering and variation in pod fly abundance over time. Since levels of resistance to this pest in the cultivated pigeonpea are low to moderate, it is important to identify pigeonpea cultivar that permits slow growth or lesser population buildup of pod fly. Different cultivars have different levels of damage. The potential for developing cultivars with high levels of resistance appears to be good (Shanower *et al.*, 1998) [12]. Identification and cultivation of cultivars which are less preferred by pod fly have numerous advantages, particularly for an eco-friendly management of pigeonpea pests. Therefore, present investigations were conducted to identify the pigeonpea superior genotypes against infestation of *M. obtusa*.

2. Material and Methods

A field experiment was conducted in randomized block design with three replications at Research Farm, Agricultural Entomology Unit, Agricultural Research Station, Badnapur (Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani), Maharashtra, India during *Kharif* season of 2015-2016 to identify the pigeonpea superior genotypes against infestation of pod fly, *Melanagromyza obtusa* (Malloch). Total 20 pigeonpea genotypes were evaluated during the study. The plot size was three rows of 5.4 m length (5.4 m × 2.4 m = 12.96 m^2); and row to row and plant to plant distance was maintained at 60 cm and 30 cm, respectively. All recommended cultural and agronomical practices were followed homogeneously in all the genotypes to raise a good crop. None of the insecticide was applied to protect the crop from infestation of *M. obtusa*. The genotypes were raised under rainfed conditions and only a protective irrigation was provided during flowering stage of the crop. The pest reaction was recorded from pod initiation till harvest of the crop. Hand picking of pod borer, *Helicoverpa armigera* (Hubner) larvae and other pest on pods was done to avoid the losses caused by them. The pod and grain damage due to *M. obtusa* was counted from 100 randomly selected pods covering all the plants of each genotype on weekly basis (Keval *et al*., 2010; and Patange *et. al*., 2017) [13, 14]. All the data recorded were subjected to statistical analysis as per the randomized block design procedure to draw meaningful conclusions.

Per cent pod and grain damage was calculated by using following formulae as suggested by Naresh and Singh, 1984 [15] and Patange *et al.*, 2017 [14].

$$\text{Per cent pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

$$\text{Per cent grain damage} = \frac{\text{Number of damaged grains}}{\text{Total number of grains}} \times 100$$

3. Results and Discussion

The data on pod damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) during the crop period *i.e.* 44^{th} to 07^{th} SMW is presented in Table 1. All the genotypes indicated significant variation regarding pod damage due to pod fly. The pod damage due to *M. obtusa* was in the range of 1.33 to 100.00 per cent on the genotypes under study. The pod damage due to *M. obtusa* ranged from 15.00 to 90.33 per cent in BDN-2, 4.00 to 30.67 per cent in BDN-2010-1, 12.00 to 76.00 per cent in BDN-2013-41, 10.00 to 86.00 per cent in BDN-2014-1, 18.67 to 72.33 per cent in BDN-2014-3, 22.00 to 84.33 per cent in BSMR-736, 38.33 to 88.33 per cent in BSMR-846, 10.00 to 58.00 per cent in KALI TUR, 19.00 to 93.67 per cent 100 pods in KHADKI, 8.67 to 78.00 per cent in GULYAL, 35.00 to 96.67 per cent in BRG-1, 58.67 to 100.00 per cent in BRG-2, 17.67 to 85.00 per cent in LRG-41, 39.67 to 92.67 per cent in ICP-7035, 13.33 to 48.00 per cent in ICP-10531, 39.00 to 80.00 per cent in ICP-322, 6.33 to 27.00 per cent in BSR-1, 2.67 to 19.00 per cent in V-127 and 0.00 to 18.00 per cent in *Cajanus cajanifolius*, respectively, wherein, *Cajanus scarabaeoides* shown no pod damage due to *M. obtusa* indicating that it is highly resistant to *M. obtusa*.

The pod damage was significantly lowest on genotypes *Cajanus scarabaeoides* (no pod damage), *Cajanus cajanifolius* (3.75 per cent), V-127 (9.16 per cent), BDN-2010-1 (15.67 per cent), BSR-1 (16.53 per cent) and ICP-10531 (29.35 per cent) with at par reaction, respectively during the crop period *i.e.* 44^{th} to 07^{th} SMW. This was followed by KALI TUR (32.49 per cent), BDN-2013-41 (42.90 per cent), BDN-2014-3 (43.98 per cent), GULYAL (44.45 per cent), BDN-2014-1 (52.12 per cent), LRG-41 (53.29 per cent) and BSMR-736 (55.18 per cent) shown moderate pod damage levels and having at par effect with each other, respectively. Whereas, the genotypes, BRG-2 (89.75 per cent) recorded highest pod damage due to pod fly, *M. obtusa* and was at par with BRG-1 (77.65 per cent), ICP-7035 (70.98 per cent), BSMR-846 (64.59 per cent), KHADKI (62.80 per cent), ICPL-322 (60.18 per cent) and BDN-2 (58.86 per cent), respectively.

The results on pod damage due to *M. obtusa* are in accordance with the observations recorded by Gangrade (1963) [16] wherein, the extent of damage to pods of five tur varieties *viz*., Sahadol, No. 148, Hyderabad, Nizamabad and Local ranged from 29 to 100, 45 to 54, 40 to 54 and 30 to 60 per cent, respectively. Sheriff and Rajagopalan (1971) [17] reported that early variety No. 1141 showed maximum infestation of pods *i.e.* 38.60 per cent followed by two medium duration varieties *viz*., M.S. 9310 and S.A. 1 recorded 18.60 and 28.40 per cent pod infestation, respectively whereas, five late maturing varieties viz., Hawai 39 (W), Arahar Arabab, Niphad T. 84, Udgir and Rahar C. 38 showed minimum pod infestation by pod fly. Similarly, Ahmad (1982) [18] reported that pod infestation varied from 4.5 to 33.0 per cent, wherein 41 varieties showed more than 10 per cent infestations in pods and the varieties; MC_7R_3, $MC_7R_1P_2$, UC-1447R, UC-1447R, MC_2R_2, $MC_1R_4P_2$ and MC5R1 showed less than 10 per cent pod infestation, respectively. Naresh *et al*. (1983) [19] reported that pod damage due to *M. obtusa* on eight tur varieties ranged from 8.12 (Prabhat) to 27.50 (TT-3-3) per cent. Pandey *et al*. (1984) [20] observed that all the varieties suffered from pod fly attack and the pod infestation ranged from minimum of 30.30 per cent in ICPL-319 to maximum of 81.01 per cent in BDN-1 among 18 pigeonpea varieties tested against pod fly. Durairaj and Ganapathy (1997) [21] reported that entries, PDA882E and PDA921E recorded lowest pod fly damage (14.3 and 6.7 per cent, respectively) and in other entries, pod damage by pod fly was 7.3 and 25.1 per cent in PDA923E and Bahar, respectively. Whereas, Sharma *et al*. (2003) [22] reported that accessions belonging to *Cajanus scarabaeoides* (L.) Thouars showed resistance to pod fly damage, while those from *C. cajanifolius* (Haines) van der Maesen were susceptible, the accessions, ICPW 141, ICPW 278 and ICPW 280 (*C. scarabaeoides*) showed resistance to pod fly damage. Moudgal *et al*. (2009) [23] reported that none of the accessions were free from pod fly damage among preliminary evaluated 260 pigeonpea accessions and among them, only four pigeonpea accessions *viz.*, GP75, GPI18, GP233 and GP253 proved least susceptible with lowest pod damage ranging from 3.76 to 5.24. Similarly, Khan *et al*. (2014) [24] recorded a wide range of variation in pod damage (21.00 to 38.50 per cent) among 24 pigeonpea genotypes tested and also reported that pod damage due to *M. obtusa* in ICPL 85063 (21.00 per cent) had rating of four on the scale which depicts it is least susceptible than local check, ‘Bahar’. Kumar *et al*. (2015) [25] reported that pod damage caused by pod fly ranged from 24.67 to 88.67 per cent in 40 tested genotypes and the genotype, ICP 14887 recorded least damage (24.67%) and the highest pod damage was observed in ICP 9150 (88.67 per cent), respectively.

Table 1: Pod damage due to *Melanagromyza obtusa* (Malloch) in different accessions of pigeonpea.

Accessions	Pod Damage (per cent) Period (Standard Meteorological Week)																
	44	45	46	47	48	49	50	51	52	01	02	03	04	05	06	07	Mean
BDN-2	15.00 (22.79)	26.00 (30.66)	37.00 (37.46)	43.00 (40.98)	48.00 (43.85)	55.00 (47.87)	65.33 (53.93)	71.00 (57.42)	77.00 (61.34)	86.00 (68.03)	87.67 (69.44)	90.33 (71.89)	88.00 (69.73)	70.00 (56.79)	49.00 (44.43)	26.67 (31.09)	58.86 (50.10)
BDN-2010-1	4.00 (11.54)	6.33 (14.58)	8.67 (17.12)	9.00 (17.46)	12.33 (20.56)	14.67 (22.52)	14.67 (22.52)	16.67 (24.09)	20.67 (27.04)	23.67 (29.11)	28.00 (31.95)	30.67 (33.63)	20.00 (26.57)	17.00 (24.35)	15.67 (23.32)	10.67 (19.06)	15.67 (23.32)
BDN-2013-41	12.00 (20.27)	17.00 (24.35)	23.00 (28.66)	26.00 (30.66)	34.00 (35.67)	45.00 (42.13)	51.00 (45.57)	57.00 (49.02)	56.00 (48.45)	64.00 (53.13)	68.00 (55.55)	76.00 (60.67)	72.00 (58.05)	28.00 (31.95)	21.67 (27.74)	13.67 (21.70)	42.90 (40.92)
BDN-2014-1	10.00 (18.43)	18.00 (25.10)	20.33 (26.80)	23.00 (28.66)	35.00 (36.27)	40.67 (39.62)	49.00 (44.43)	61.00 (51.35)	67.00 (54.94)	68.00 (55.55)	72.33 (58.27)	85.33 (67.48)	86.00 (68.03)	79.00 (62.73)	63.00 (52.54)	38.67 (38.45)	52.12 (46.21)
BDN-2014-3	18.67 (25.60)	24.00 (29.33)	27.00 (31.31)	32.00 (34.45)	35.00 (36.27)	44.00 (41.55)	49.67 (44.81)	55.33 (48.06)	61.33 (51.55)	65.00 (53.73)	67.33 (55.14)	72.33 (58.27)	51.00 (45.57)	34.67 (36.07)	32.33 (34.65)	25.00 (30.00)	43.98 (41.54)
BSMR-736	22.00 (27.97)	31.00 (33.83)	34.33 (35.87)	43.00 (40.98)	50.33 (45.19)	56.33 (48.64)	61.33 (51.55)	66.00 (54.33)	72.00 (58.05)	76.00 (60.67)	80.67 (63.92)	84.33 (66.68)	73.00 (58.69)	64.00 (53.13)	49.00 (44.43)	34.67 (36.07)	55.18 (47.97)
BSMR-846	38.33 (38.25)	46.67 (43.09)	45.00 (42.13)	53.00 (46.72)	59.33 (50.38)	65.00 (53.73)	72.33 (58.27)	79.33 (62.96)	81.33 (64.40)	83.33 (65.91)	85.67 (67.75)	88.33 (70.03)	78.00 (62.03)	66.00 (54.33)	52.00 (46.15)	48.00 (43.85)	64.59 (53.48)
KALI TUR	10.00 (18.43)	14.67 (22.52)	18.00 (25.10)	23.00 (28.66)	24.67 (29.78)	30.00 (33.21)	35.67 (36.67)	36.33 (37.07)	41.00 (39.82)	43.33 (41.17)	49.00 (44.43)	58.00 (49.60)	47.00 (43.28)	37.33 (37.66)	30.67 (33.63)	25.00 (30.00)	32.49 (34.75)
KHADKI	19.00 (25.84)	26.67 (31.09)	35.00 (36.27)	44.33 (41.75)	57.00 (49.02)	66.00 (54.33)	73.33 (58.91)	79.00 (62.73)	83.67 (66.16)	87.00 (68.87)	87.00 (68.87)	93.67 (75.42)	78.00 (62.03)	67.00 (54.94)	56.00 (48.45)	43.00 (40.98)	62.80 (52.42)
GULYAL	8.67 (17.12)	15.67 (23.32)	22.00 (27.97)	25.67 (30.44)	32.67 (34.86)	38.00 (38.06)	41.00 (39.82)	47.00 (43.28)	54.00 (47.29)	59.00 (50.18)	73.00 (58.69)	78.00 (62.03)	69.00 (56.17)	61.00 (51.35)	53.33 (46.91)	31.67 (34.24)	44.45 (41.81)
BRG-1	35.00 (36.27)	53.33 (46.91)	58.67 (49.99)	67.67 (55.35)	74.00 (59.34)	78.67 (62.49)	79.00 (62.73)	82.33 (65.15)	88.00 (69.73)	92.00 (73.57)	94.67 (76.65)	96.67 (79.48)	90.00 (71.57)	86.00 (68.03)	80.33 (63.67)	73.00 (58.69)	77.65 (61.78)
BRG-2	58.67 (49.99)	71.33 (57.63)	79.00 (62.73)	82.00 (64.90)	86.33 (68.30)	88.67 (70.33)	90.00 (71.57)	94.33 (76.23)	95.67 (77.99)	96.67 (79.48)	99.00 (84.26)	100.00 (90.00)	99.00 (84.26)	97.67 (81.21)	96.50 (79.22)	92.00 (73.57)	89.75 (71.33)
LRG-41	17.67 (24.85)	24.67 (29.78)	29.67 (33.00)	35.67 (36.67)	41.67 (40.20)	45.33 (42.32)	56.67 (48.83)	66.67 (54.74)	73.00 (58.69)	77.00 (61.34)	79.33 (62.96)	85.00 (67.21)	77.00 (61.34)	67.67 (55.35)	56.00 (48.45)	33.00 (35.06)	53.29 (46.89)
ICP-7035	39.67 (39.04)	47.67 (43.66)	55.67 (48.25)	63.00 (52.54)	67.67 (55.35)	73.67 (59.13)	78.67 (62.49)	82.33 (65.15)	85.67 (67.75)	88.00 (69.73)	89.67 (71.25)	92.67 (74.29)	86.00 (68.03)	75.67 (60.44)	66.00 (54.33)	53.00 (46.72)	70.98 (57.40)
ICP-10531	13.33 (21.42)	18.00 (25.10)	23.00 (28.66)	27.00 (31.31)	29.00 (32.58)	30.67 (33.63)	34.00 (35.67)	35.00 (36.27)	38.33 (38.25)	41.00 (39.82)	44.00 (41.55)	48.00 (43.85)	32.00 (34.45)	24.00 (29.33)	19.67 (26.33)	16.00 (23.58)	29.35 (32.81)
ICPL-322	39.00 (38.65)	47.00 (43.28)	56.67 (48.83)	59.00 (50.18)	63.00 (52.54)	53.00 (46.72)	55.67 (48.25)	59.67 (50.57)	69.00 (56.17)	74.67 (59.78)	77.67 (61.80)	80.00 (63.43)	68.33 (55.76)	59.00 (50.18)	51.00 (45.57)	41.33 (40.01)	60.18 (50.87)
BSR-1	6.33 (14.58)	8.00 (16.43)	10.00 (18.43)	13.00 (21.13)	15.33 (23.05)	15.00 (22.79)	17.33 (24.60)	20.00 (26.57)	21.00 (27.27)	23.00 (28.66)	25.00 (30.00)	27.00 (31.31)	23.00 (28.66)	17.33 (24.60)	13.00 (21.13)	9.00 (17.46)	16.53 (23.99)
V-127	2.67 (9.40)	2.33 (8.79)	3.33 (10.52)	4.33 (12.01)	5.33 (13.35)	8.00 (16.43)	11.00 (19.37)	11.00 (19.37)	11.67 (19.97)	14.67 (22.52)	17.00 (24.35)	19.00 (25.84)	13.00 (21.13)	9.00 (17.46)	6.67 (14.96)	3.67 (11.04)	9.16 (17.61)
Cajanus cajanifolius	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.00 (11.54)	8.33 (16.78)	18.00 (25.10)	17.00 (24.35)	10.00 (18.43)	1.33 (6.63)	0.00 (0.00)	3.75 (11.16)
Cajanus scarabaeoides	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
SE (m) ±	1.25	1.31	1.44	1.55	1.67	0.67	0.72	0.96	1.08	0.85	0.97	0.97	0.92	1.25	0.96	1.08	0.70
CD at 5%	3.59	3.76	4.13	4.44	4.77	1.91	2.06	2.74	3.09	2.44	2.76	2.77	2.64	3.57	2.75	3.09	1.99
CV %	9.59	8.41	8.21	8.09	7.95	2.98	3.00	3.76	4.01	2.97	3.20	3.00	3.20	4.98	4.37	5.93	2.99

Figures of percentage in parenthesis are angular transformed values.

The data on grain damage due to pigeonpea pod fly, *Melanagromyza obtusa* (Malloch) during the crop period *i.e.* 44th to 07th SMW is presented in Table 2. All the genotypes indicated significant variation regarding grain damage. The grain damage due to *M. obtusa* was observed in the range of 0.71 to 91.53 per cent on the genotypes under study. The grain damage due to *M. obtusa* ranged from 10.00 to 57.39 per cent in BDN-2, 2.03 to 19.24 per cent in BDN-2010-1, 5.82 to 45.03 per cent in BDN-2013-41, 5.90 to 58.97 per cent in BDN-2014-1, 8.29 to 33.29 per cent in BDN-2014-3, 12.22 to 43.06 per cent in BSMR-736, 33.70 to 73.15 per cent in BSMR-846, 5.95 to 40.00 per cent in KALI TUR, 16.12 to 77.46 per cent 100 pods in KHADKI, 6.21 to 56.82 per cent in GULYAL, 31.79 to 91.31 per cent in BRG-1, 53.37 to 91.53 per cent in BRG-2, 14.30 to 69.79 per cent in LRG-41, 35.44 to 87.60 per cent in ICP-7035, 6.81 to 24.35 per cent in ICP-10531, 17.31 to 48.21 per cent in ICP-322, 3.00 to 14.50 per cent in BSR-1, 0.79 to 7.57 per cent in V-127 and 0.00 to 5.10 per cent in *Cajanus cajanifolius*, respectively, wherein, *Cajanus scarabaeoides* shown no grain damage due to *M. obtusa* indicating its genetic potentiality against *M. obtusa* and it can be used as source of resistance against pod fly in breeding programmes.

The grain damage was significantly lowest on genotypes, *Cajanus scarabaeoides* (no grain damage), *Cajanus cajanifolius* (1.07 per cent) followed by V-127 (3.82 per cent), BDN-2010-1 (8.46 per cent), BSR-1 (9.36 per cent) and ICP-10531 (14.83 per cent) having at par reaction, respectively during crop period *i.e.* 44th to 07th SMW. This was followed by BDN-2014-3 (19.68 per cent), KALI TUR (21.10 per cent), BDN-2013-41 (23.01 per cent), BSMR-736 (29.84 per cent), GULYAL (31.88 per cent), ICPL-322 (32.62 per cent), BDN-2014-1 (34.43 per cent) and BDN-2 (36.06 per cent) shown moderate grain damage levels and having at par effect with each other, respectively. Whereas, the genotypes, BRG-2 (82.02 per cent) recorded highest grain damage due to pod fly, *M. obtusa* and was at par with BRG-1 (71.53 per cent), ICP-7035 (65.14 per cent), BSMR-846 (51.20 per cent), KHADKI (43.72 per cent) and LRG-41 (43.65 per cent), respectively.

The results in relation to grain damage due to pod fly on pigeonpea genotypes under study is in accordance with; Gangrade (1963) [16] who reported that the grain damage of five tur varieties ranged from 11.40 to 86.80 per cent in Shahdol, 23.30 to 29.80 per cent in No. 148, 21.30 to 29.00 in Nizamabad, 13.10 to 32.20 per cent in Hyderabad and 13.20 to 37.20 per cent in local, respectively. Whereas, Sheriff and Rajagopalan (1971) [17] reported that the early variety No. 1141 showed maximum infestation of grains *i.e.* 33.00 per cent followed by two medium duration varieties *viz.*, M.S.

9310 and S.A. 1 recorded 8.00 and 11.00 per cent grain infestation, respectively whereas, five late maturing varieties viz., Hawai 39 (W), Arahar Arabab, Niphad T. 84, Udgir and Rahar C. 38 showed minimum grain infestation by pod fly. Similarly, Borikar and Wadnerkar (1979) [26] found Prabhat (2.00 per cent), HY-1 (2.80 per cent) and Pusa Ageti (3.80 per cent) with least percentage of pod fly affected grains, while No. 134 (16.40 per cent) and ICRISAT-6997 (12.60 per cent) shown the highest, and the varieties BS-1 (4.80 per cent), 7585-2-V2 (6.00 per cent), C-11 (7.60 per cent) and No. 148 (8.20 per cent) shown intermittent level of grain infestation, respectively. Ahmad (1982) [18] reported that seed infestation varied from 2.4 to 17.4 per cent; wherein more than 5 per cent damaged seeds were found in each of the 38 varieties and the varieties MC_7R_3, $MC_7R_1P_2$, UC-1447R, UC-1447R, MC_2R_2, $MC_1R_4P_2$ and MC5R1 showed low per cent grain damage, respectively. Naresh *et al*. (1983) [19] reported that the grain damage due to *M. obtusa* in eight tur varieties *viz*., ICPL-5EB-EB, Pant A-1, Prabhat, ICPL-5BE-EB, UPAS-120, MLT-1, TT-3-3 and Pant A-3 ranged from 4.16 (Prabhat) to 11.90 (TT-3-3) per cent. Pandey *et al*. (1984) [20] observed that the per cent grain damage in pigeonpea due to pod fly was found to vary from 16.32 per cent in ICPL-319 to the maximum of 44.88 per cent in UPAS-120 among the 18 pigeonpea varieties tested against pod fly. Lal and Yadav (1994) [27] revealed that resistant selections SL 122, SL 423, ICP 7946, ICP 7151, GP 33 and ICP 8102 showed consistently low (11-14 per cent) grain damage by pod fly compared with susceptible selections CODE 3, ICP 7050, D 3 and JM 2412 (27-33 per cent grain damage). Also, Khan *et al*. (2014) [24] observed a wide range of variation of seed (12.29 to 19.87 per cent) damage with check 'Bahar' genotype and genotype, ICP10531 (12.36 per cent) had the least grain damage, respectively. Kumar *et al*. (2015) [25] reported that pod damage caused by pod fly ranged from 15.12 to 45.56 per cent and highest grain damage was recorded in cultivar ICP 9150 (45.56 per cent) and the lowest grain damage of 15.12 per cent was recorded in ICP 14887 and it was found at par with the accessions BDN 2 (17.07 per cent), respectively while, check LRG-41 recorded grain damage to an extent of 29.29 per cent.

Table 2: Grain damage due to *Melanagromyza obtusa* (Malloch) in different pigeonpea accessions.

Accessions	**Damage (per cent) Period (Standard Meteorological Week)**																
	44	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**Mean**
BDN-2	10.00 (18.43)	17.68 (24.87)	21.74 (27.79)	27.68 (31.74)	30.87 (33.75)	35.07 (36.31)	41.01 (39.82)	44.49 (41.84)	48.41 (44.09)	53.48 (46.99)	55.07 (47.91)	57.39 (49.25)	52.75 (46.58)	42.32 (40.58)	29.57 (32.94)	17.10 (24.43)	36.06 (36.91)
BDN-2010-1	2.03 (8.18)	3.80 (11.24)	5.19 (13.17)	6.08 (14.27)	6.46 (14.72)	7.59 (16.00)	8.73 (17.19)	9.37 (17.82)	10.51 (18.91)	11.27 (19.61)	13.42 (21.49)	19.24 (26.02)	12.03 (20.29)	8.99 (17.44)	6.33 (14.57)	4.30 (11.97)	8.46 (16.91)
BDN-2013-41	5.82 (13.96)	8.52 (16.97)	12.36 (20.58)	14.91 (22.72)	16.90 (24.28)	22.02 (27.98)	28.55 (32.30)	31.82 (34.34)	30.97 (33.81)	36.08 (36.92)	40.48 (39.51)	45.03 (42.15)	40.77 (39.68)	15.63 (23.28)	10.94 (19.31)	8.10 (16.53)	23.01 (28.66)
BDN-2014-1	5.90 (14.05)	12.31 (20.54)	14.49 (22.37)	17.05 (24.39)	22.44 (28.27)	25.13 (30.08)	32.05 (34.48)	36.79 (37.34)	44.49 (41.83)	47.18 (43.38)	49.62 (44.78)	58.97 (50.17)	58.21 (49.72)	53.08 (46.76)	38.21 (38.18)	25.51 (30.34)	34.43 (35.93)
BDN-2014-3	8.29 (16.74)	10.98 (19.35)	12.68 (20.86)	13.78 (21.79)	15.37 (23.08)	18.41 (25.41)	21.46 (27.60)	23.54 (29.02)	27.56 (31.67)	29.02 (32.60)	31.46 (34.12)	33.29 (35.24)	24.02 (29.35)	17.68 (24.87)	15.73 (23.37)	11.10 (19.46)	19.68 (26.33)
BSMR-736	12.22 (20.46)	17.36 (24.62)	19.17 (25.96)	23.19 (28.79)	27.08 (31.36)	29.86 (33.12)	32.36 (34.67)	33.89 (35.60)	35.97 (36.85)	37.08 (37.51)	40.00 (39.23)	43.06 (41.01)	40.00 (39.23)	35.28 (36.44)	26.94 (31.27)	18.06 (25.15)	29.84 (33.11)
BSMR-846	33.70 (35.49)	36.03 (36.89)	38.36 (38.27)	41.37 (40.03)	48.36 (44.06)	50.68 (45.39)	49.86 (44.92)	60.41 (51.01)	56.71 (48.86)	57.67 (49.41)	63.15 (52.62)	73.15 (58.79)	65.75 (54.18)	51.92 (46.10)	46.58 (43.04)	42.88 (40.90)	51.20 (45.69)
KALI TUR	5.95 (14.12)	8.61 (17.06)	10.38 (18.79)	13.80 (21.81)	16.20 (23.74)	18.99 (25.83)	21.39 (27.55)	23.80 (29.20)	26.20 (30.79)	28.73 (32.41)	35.44 (36.54)	40.00 (39.23)	30.63 (33.61)	26.46 (30.95)	19.11 (25.93)	17.34 (24.61)	21.10 (27.34)
KHADKI	16.12 (23.67)	19.55 (26.24)	25.37 (30.25)	31.49 (34.14)	36.42 (37.12)	39.55 (38.97)	46.27 (42.86)	51.94 (46.11)	56.72 (48.86)	59.55 (50.51)	66.27 (54.49)	77.46 (61.66)	56.72 (48.86)	50.90 (45.51)	43.28 (41.14)	33.28 (35.23)	43.72 (41.39)
GULYAL	6.21 (14.43)	11.21 (19.56)	15.76 (23.39)	18.48 (25.46)	23.48 (28.99)	27.58 (31.68)	29.85 (33.12)	33.79 (35.54)	38.94 (38.61)	42.88 (40.91)	53.33 (46.91)	56.82 (48.92)	49.85 (44.91)	44.55 (41.87)	38.79 (38.52)	22.58 (28.37)	31.88 (34.37)
BRG-1	31.79 (34.32)	51.55 (45.89)	56.79 (48.90)	63.69 (52.95)	59.29 (50.35)	73.45 (58.99)	74.64 (59.76)	77.62 (61.77)	82.62 (65.36)	87.50 (69.30)	89.05 (70.67)	91.31 (72.85)	82.98 (65.63)	80.71 (63.95)	75.83 (60.55)	70.48 (57.09)	71.53 (57.76)
BRG-2	53.37 (46.93)	65.51 (54.04)	72.24 (58.21)	74.69 (59.80)	79.08 (62.78)	80.71 (63.95)	82.24 (65.08)	86.33 (68.30)	87.76 (69.52)	88.37 (70.06)	90.61 (72.16)	91.53 (73.08)	90.41 (71.96)	89.18 (70.80)	87.65 (69.43)	84.08 (66.49)	82.02 (64.91)
LRG-41	14.30 (22.22)	19.98 (26.55)	24.08 (29.39)	29.03 (32.60)	34.01 (35.68)	37.24 (37.61)	46.14 (42.79)	54.32 (47.48)	59.72 (50.60)	62.93 (52.50)	65.27 (53.89)	69.79 (56.66)	63.21 (52.66)	54.89 (47.81)	45.56 (42.45)	26.88 (31.23)	43.63 (41.34)
ICP-7035	35.44 (36.53)	42.23 (40.53)	48.58 (44.19)	57.92 (49.56)	60.60 (51.12)	64.71 (53.56)	71.47 (57.72)	76.38 (60.92)	78.60 (62.45)	83.39 (65.95)	84.91 (67.14)	87.60 (69.38)	81.52 (64.54)	66.71 (54.76)	57.81 (49.49)	44.47 (41.83)	65.14 (53.81)
ICP-10531	6.81 (15.13)	9.13 (17.59)	11.74 (20.04)	13.62 (21.66)	14.93 (22.73)	15.65 (23.31)	17.10 (24.43)	17.68 (24.87)	19.71 (26.36)	21.01 (27.28)	22.32 (28.19)	24.35 (29.57)	16.23 (23.76)	12.32 (20.55)	9.86 (18.30)	8.12 (16.55)	14.83 (22.65)
ICPL-322	17.31 (24.59)	20.60 (26.99)	24.48 (29.65)	26.27 (30.83)	27.76 (31.80)	31.49 (34.14)	33.13 (35.14)	35.37 (36.50)	38.51 (38.36)	44.33 (41.74)	46.27 (42.86)	48.21 (43.97)	40.90 (39.75)	35.22 (36.41)	30.45 (33.49)	24.78 (29.85)	32.62 (34.83)
BSR-1	3.00 (9.97)	4.00 (11.54)	4.88 (12.76)	7.75 (16.16)	8.75 (17.21)	9.38 (17.83)	10.38 (18.79)	11.63 (19.94)	12.38 (20.60)	12.88 (21.03)	13.50 (21.56)	14.50 (22.38)	12.25 (20.49)	9.88 (18.32)	7.38 (15.76)	5.00 (12.92)	9.36 (17.81)
V-127	0.79 (5.11)	0.93 (5.53)	1.20 (6.28)	2.13 (8.39)	2.53 (9.14)	2.93 (9.85)	4.52 (12.27)	5.45 (13.50)	4.92 (12.82)	6.11 (14.31)	6.64 (14.94)	7.57 (15.98)	5.18 (13.16)	3.99 (11.52)	2.52 (9.14)	1.60 (7.26)	3.8 (11.27)
Cajanus cajanifolius	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.12 (6.08)	2.24 (8.62)	5.10 (13.05)	4.80 (12.65)	2.86 (9.73)	0.71 (4.85)	0.00 (0.00)	1.07 (5.93)
Cajanus scarabaeoides	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
SE (m) ±	0.76	0.65	0.73	0.80	0.94	0.76	0.57	0.71	0.82	0.64	0.62	0.61	0.72	0.89	0.86	0.72	0.49
CD at 5%	2.18	1.86	2.09	2.29	2.69	2.19	1.64	2.03	2.34	1.83	1.77	1.75	2.05	2.56	2.46	2.06	1.40
CV %	7.08	5.08	5.16	5.16	5.72	4.34	3.05	3.56	3.94	2.93	2.69	2.49	3.22	4.50	4.87	4.80	2.66

Figures of percentage in parenthesis are angular transformed values.

4. Conclusion

From the present studies, it can be concluded that the pod fly, *Melanagromyza obtusa* is a major emerging constraint playing an important role in pigeonpea yield reduction. The pod and grain damage due to *M. obtusa* was ranged from 1.33 to 100.00 and 0.71 to 91.53 per cent, respectively. The genotype *Cajanus scarabaeoides* shown no pod and grain damage due to *M. obtusa*, indicating that the genotype is having most resistance against *M. obtusa* infestation and it can be used in breeding programmes in order to produce resistant cultivars for the benefit of farmers. Among the released varieties, V-127 (9.16 and 3.82 per cent), BDN-2010-1 (15.67 and 8.46 per cent) and BSR-1 (16.53 and 9.36 per cent) shown lowest pod and grain damage, indicating their high level of resistance against *M. obtusa* and these can be recommended for cultivation under farmers fileds.

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