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International Journal of Interdisciplinary Research
ISSN 2348-6775 (Online)
2349-5480 (Print)

ASSESSMENT OF LOSSES DUE TO ATTACK OF *CALLOSOBRUCHUS MACULATUS* FAB. ON DIFFERENT PIGEON PEA VARIETIES

Deepshikha Viola Raj	**School of Entomology, St. John's College, Agra**
Dinesh Lal	**School of Entomology, St. John's College, Agra**

Abstract

A laboratory study was conducted to investigate the damage caused by the infestation of *Callosobruchus maculatus* (Fab) on the promising varieties of pigeonpea, *Cajanus cajan* Linn. The promising genotypes used to conduct the study were AMAR, T-21, BAHAR, PDA-9, KUDRAT, ICPL366, T-7, ICP7035, MA-2 and IPA 613. At the end of experiment after 90 days grains and their particles were weighed after removing all dust, insects and their stages. The difference was recorded between initial and final weight to access the loss of weight in grains. Percentage damaged grains was also recorded by examining each grain individually. Infestation of pulse beetle on different pigeon pea varieties was determined by counting the number of damaged grain in each variety in each sample replication and the data were converted in percentage of infestation. Weight loss by *C. maculatus* was least in variety AMAR (24.52%) followed by KUDRAT, BAHAR, ICP 7035, IPA 613, MA-2, PDA–9, T-21 and ICPL 366 (28.48, 40.20, 44.32, 44.53, 45.64, 46.79, 53.26 and 58.18%). Maximum weight loss was found in variety T-7 (61.40 %). It is evident from the observations that minimum grain damage by the pest was found in variety AMAR (37.89 %), followed IPA 613, ICP 7035, KUDRAT, BAHAR and MA-2 viz; 54.58, 55.38, 58.52, 64.12 and 64.19% respectively. The varieties T-21 and PDA-9 showed intermediate grain damage in response to infestation by the pest (65.70 to 66.58%). Grain damage was relatively higher (74.38 and 78.16%) in varieties of ICPL 366 and T-7.

Introduction

Pulse beetle is one of the most serious destructive pests for pigeon pea and cow pea. Pigeon pea is a major source of protein in areas where it is cultivated. Pulse beetle, *Callosobruchus* spp. causes a potential loss in legume by feeding on the protein content of grain and their damage ranges from 12-13% in developing countries (Mohan and Subbarao, 2000). When it infests the smaller seed it consumes virtually all the cotyledons, thereby removing all possible chance of germination of the seed (Boeke *et al*., 2003). In addition to direct weight loss, bruchids also render quantitative and qualitative loss which may include presence of contaminants, such as uric acid and other nitrogenous wastes, presence of adult bruchids inside the seed, exit holes, glued eggs to the seeds, cast-off larval skin, pieces of insect chitin and changes in appearance, texture and taste, making it unfit for human consumption (Venkatrao *et al*., 1960; Nchimbi-Mosolla and Miswangu, 2002 and Ahmed *et al*. (2003).

The post harvest seed losses may reach up to 100% (Udo and Epidi, 2009 and Koona, 2006). Besides production constraints, post harvest loss of chick pea is very high in farmers' storage conditions

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(Rahman and Talukder, 2006). According to Lale and Ofuya (2001) and Ashamo (2004) *C. maculatus* consumes 50-90% of cowpea in storage annually throughout tropical Africa and causes serious management problems in the agriculture of developing countries. The insect multiplies very rapidly in storage where it causes very high losses.

Bruchids (*C. analis, C. chinensis and C. maculatus*) are of significant economic importance as major insect pests of leguminous grains such as cowpeas, lentils, green gram, and black gram (Raja *et al*., 2000; Shafique and Ahmad, 2002; Park *et al*., 2003 and Deborah and Credland, 2003). Karthikeyan *et al*. (2008) compared the susceptibility of improved local cultivars of pulses to pulse beetle, *C. maculatus*. Results showed that the resistance status of infested seeds of pigeon pea was lower as compared to other pulses.

Materials and Methods

Mass culture of *Callosobruchus maculatus* was maintained. For above each experiment was replicated thrice having 25 g seed in separate glass vials measuring 10×3 cm. For loss assessment 5 pairs of adults were placed in tubes containing 25 gram grains of each variety. At the end of experiment after 90 days grains and their particles were weighed after removing all dust, insects and their stages. The difference was recorded between initial and final weight to access the loss of weight in grains. Percentage damaged grains was also recorded by examining each grain individually. Infestation of pulse beetle on different pigeon pea varieties was determined according to Gautam (1988) by counting the number of damaged grain in each variety in each sample replication and the data were converted in percentage of infestation.

Results and Discussion

Pulse beetle is one of the most serious destructive pests for pigeon pea and cow pea. Pigeon pea is a major source of protein in areas where it is cultivated. Pulse beetle, Callosobruchus spp., causes a potential loss in legume by feeding on the protein content of grain and their damage ranges from 12-13% in developing countries. 55-69% losses in seed weight and 45.6-66.30% losses in protein content due to damage caused by *C. maculatus*. A single larva of *C. maculatus* can remove about a quarter of the cotyledon of an average sized seed. When it infests smaller seed it consumes virtually all the cotyledons, thereby removing all possible chance of germination of the seed.

C. maculatus begins its attack shortly before harvest and continues in store where it develops. In addition to direct weight loss, bruchids also render quantitative and qualitative loss which may include presence of contaminants, such as uric acid and other nitrogenous wastes, presence of adult bruchids inside the seed, exit holes, glued eggs to the seeds, cast-off larval skin, pieces of insect chitin and changes in appearance, texture and taste, making it unfit for human consumption. The grain will thus have reduced market value and germination will also be affected. The larvae bore into the pulse grains.

C. maculatus is known to cause up to 100% loss of stored cowpea and estimates have shown that over 30 million US$ is lost as a result of cowpea damage in Nigeria.

Loss in grain weight: It is obvious from the data presented in (Table 1 and Figure 1) that minimum loss in weight due to attack of *C. maculatus* was 24.52% in AMAR, which was statistically identical with 28.48% in KUDRAT. The loss was significantly highest in case of T-7 (61.40 %). The varieties ICPL 366 and T-21 exhibiting 58.18 and 53.26% loss respectively were at par with each other but this was

ISSN 2348-6775 (Online)
2349-5480 (Print)

significantly lower loss than T-7. The loss in varieties ICP 7035, IPA 613, MA -2 and PDA-9 was moderate at 44.32, 44.53, 45.64 and 46.79%, respectively. The number of eggs laid and adult emergence are also related with weight loss. It is evident from (Table 2 and Figure 2) that weight loss increased in pigeon pea varieties with increase in egg laying. Adult emergence on different pigeon pea varieties also demonstrated a significant relationship with weight loss. Maximum weight loss was found in variety T-7 (61.40 %). Ashamo, (2004) reported that maximum weight loss in pigeon pea and cow pea is due to the infestation of *C. maculatus*. Das *et al*. (2005) reported that the degree of loss due to bruchid damage is quite variable in stored grains. Koona (2006) indicated that *C. maculatus* can cause seed loss of 20-100% at farm level if left untreated.

Grain damage: Data regarding grain damage of pigeon pea varieties due to infestation of *C. maculatus* has been presented in (Table 3 and Figure 3). It is evident from the observations that minimum grain damage by the pest was found in variety AMAR (37.89 %), followed IPA 613, ICP 7035, KUDRAT, BAHAR and MA-2 viz; 54.58, 55.38, 58.52, 64.12 and 64.19% respectively. The varieties T-21 and PDA-9 showed intermediate grain damage in response to infestation by the pest (65.70 to 66.58%). Grain damage was relatively higher (74.38 and 78.16%) in varieties of ICPL 366 and T-7. Venkatrao *et al*. (1960) also reported qualitative and quantitative loss of grain due to *C. maculatus* infestion. Khalequzzaman and Chowdhary (2003) reported *C. maculatus* as the cause of loss of weight, nutritional value and viability of stored grain.

Resistant	: -	NIL
Moderately Resistant	:-	AMAR, ICPL 366.
Intermediate Resistant	:-	IPA 613, ICP 7035.
Susceptible	:-	KUDRAT, MA2, T-7, PDA-9, BAHAR and T-21.

The percentage of average weight loss of pigeon pea due to infestation can be compared in (Table 4 and Figure-4) Grain infestation by *C. maculatus* was significantly less in variety AMAR (37.89%), which was at par with variety KUDRAT. ICP 7035 and IPA 613 being 58.52, 55.38 and 54.58%, respectively. More damaged grain was found in variety T-7 (78.16%) which was followed by ICPL 366, PDA 9, T-21, MA-2 and BAHAR (74.38, 66.58, 65.70, 64.19 and 64.12%, respectively). The average weight loss percentage was less in variety AMAR (24.52%) which was followed by KUDRAT > BAHAR > ICP 7035 > IPA 613 > MA-2 > PDA 9 > T-21 > ICPL 366 > T-7 being 28.48, 40.20, 44.32, 44.53, 45.64, 46.79, 53.26, 58.18 and 61.40%. Thus maximum weight loss was seen in variety T-7. These varieties were highly susceptible to the pest. Infestation of these insects starts in the field and continues in storage where sometimes it causes total destruction of the seeds with in a period of 3-4 months. Ali *et al*. (2004) state that the pest generates exceedingly high levels of infestation even when they pass only one or two generations on the host plant. The larvae of the bruchid feed on the pulse seed contents reducing their degree of usefulness and making them unfit either for planting or for human consumption. Udo and Harry (2013); Mogbo *et al*. (2014); Tufail *et al*. (2015) estimated that this pest causes huge loss - between 20 and 50% - on stored cowpea and sometimes the loss could be complete accounting for 100% because of its short life cycle and high reproductive capacity

ISSN 2348-6775 (Online)
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Table and Fig. -1
Weight loss percentage in pigeon pea varieties

Varieties	Weight loss percentage (%)
IPA613	44.53
MA2	45.64
ICP7035	44.32
T-7	61.40
ICPL366	58.18
KUDRAT	28.48
PDA-9	46.79
BAHAR	40.20
T-21	53.26
AMAR	24.52
S.E.M.	±3.69
CD (5%)	0.26

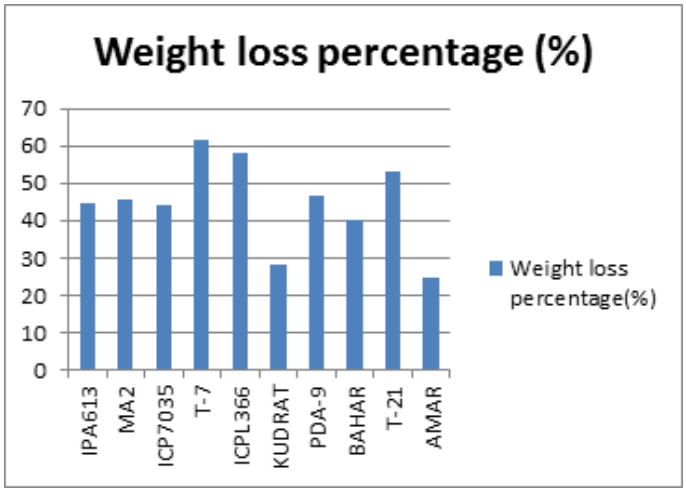
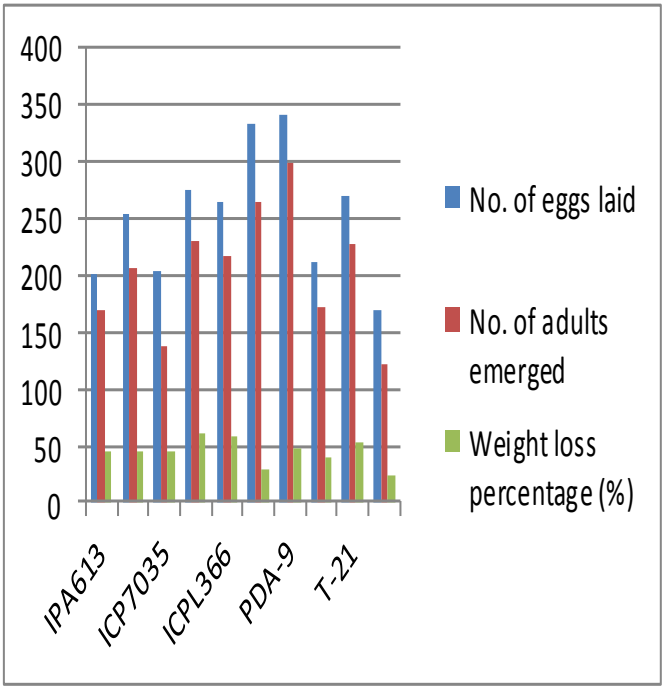


Table and Fig. - 2
Number of eggs laid, number of adults of *C. maculatus* emerged and weight loss percentage in pigeon pea varieties

Varieties	No. of eggs laid	No. of adults emerged	Weight loss percentage (%)
IPA613	202.14	168.76	44.53
MA2	254.35	206.93	45.64
ICP7035	203.49	137.81	44.32
T-7	274.39	228.88	61.40
ICPL366	264.90	216.03	58.18
KUDRAT	333.70	264.29	28.48
PDA-9	341.19	297.91	46.79
BAHAR	212.84	172.32	40.20
T-21	268.99	228.39	53.26
AMAR	168.92	121.39	24.52
S.E.M.	±17.90	±17.40	±3.69
CD (5%)	0.23	0.26	0.26



ISSN 2348-6775 (Online)
2349-5480 (Print)

Table and Fig. -3
Infestation percentage of *C. maculatus* in pigeon pea varieties

Varieties	Infestation Percentage causing grain damage (%).
IPA613	54.58
MA2	64.19
ICP7035	55.38
T-7	78.16
ICPL366	74.38
KUDRAT	58.52
PDA-9	66.58
BAHAR	64.12
T-21	65.70
AMAR	37.89
S.E.M.	±3.57
CD (5%)	0.18

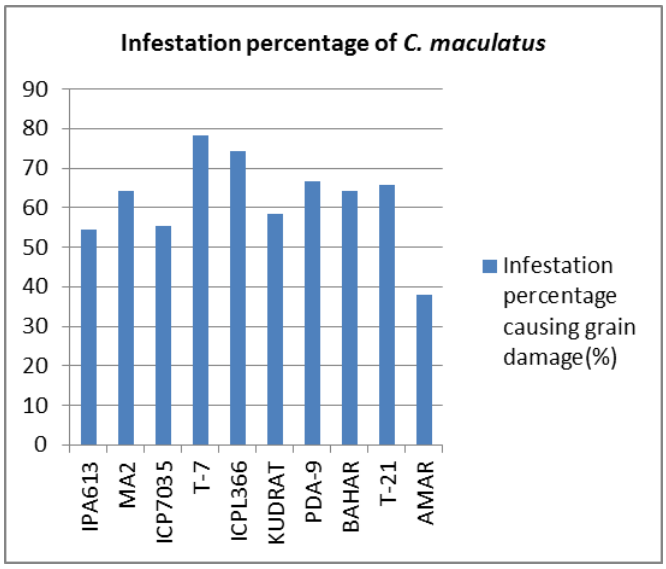
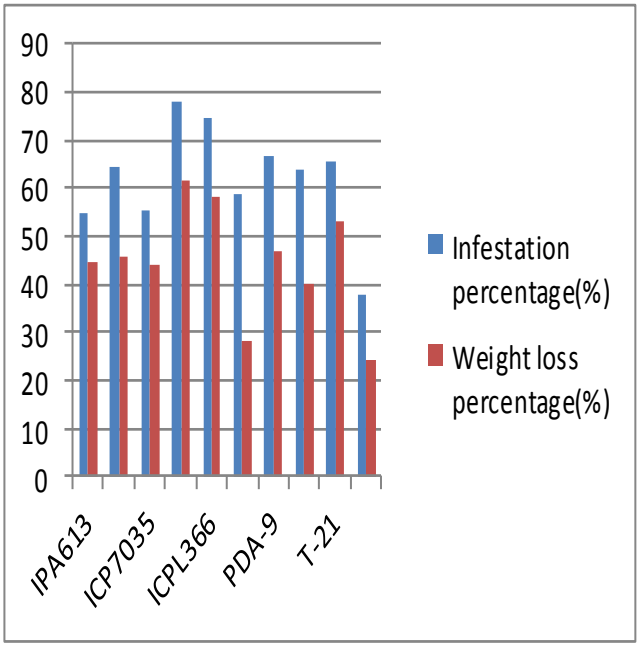


Table-4
Infestation percentage of *C. maculatus* and weight loss percentage in pigeon pea varieties

Varieties	Infestation percentage (%)	Weight loss percentage (%)
IPA613	54.58	44.53
MA2	64.19	45.64
ICP7035	55.38	44.32
T-7	78.16	61.40
ICPL366	74.38	58.18
KUDRAT	58.52	28.48
PDA-9	66.58	46.79
BAHAR	64.12	40.20
T-21	65.70	53.26
AMAR	37.89	24.52
S.E.M.	±3.57	±3.69
CD (5%)	0.18	0.26



ISSN 2348-6775 (Online)
2349-5480 (Print)

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ISSN 2348-6775 (Online)
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