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Grain Damage and Weight Loss Caused by Rice Weevil Feeding on Split Pulses

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***Abstract*:** An experiment was carried out at the Entomology Laboratory, ICAR-National Research Centre for Integrated Pest management, New Delhi in October-November 2023 to estimate the comparative storage losses in split pulses caused by *Sitophilus oryzae* L. under room and controlled conditions. A completely randomized design (CRD) was used with seven treatments (T1= sorghum, T2 = red gram, T3= chick pea, T4 = black gram, T5 = green gram, T6= roasted gram and T7= lentil) each replicated three times. The assessed parameters were per cent weight loss, number of F1 progeny and per cent grain damage. Among the split pulses red gram dal was found to be the most suitable host of pulse feeding population with 58.25 and 43.00 F1 progeny production, 93.50 and 91.25 per cent grain damage and 28.14 and 37.15 per cent weight loss under room and controlled condition followed by green gram, chick pea, black gram, roasted gram and lentil. The assessed parameters were higher in sorghum feeding population on sorghum grains than at pulse feeding population on pulse grains.

Keywords: F1 progeny, Grain damage, Weight loss, *Sitophilus oryzae* L, Split pulses.

INTRODUCTION

The rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), is one of the most destructive pest of stored cereals worldwide. It is classed as a primary pest, cosmopolitan in nature and is known to infest sound cereal seeds (Hill, 1990) and causes severe loss in rice, maize, barley and wheat (Bhatia et al., 1975; Singh et al, 1980; Neupane, 1995). Though the storage grain loss is caused by insect pests, pathogens and rodents, it is generally believed that half of the storage loss is usually caused by insects (FAO, 1968). Considering the loss caused by storage insect pests, effective methods of control are of paramount importance. Control often depends on a sound knowledge of the ecology and on the effects of a multitude of environmental factors on the life history of a pest. Reports about its occurrence on legumes are scanty. Coombs et al. (1977) reported the successful development by Trinidad strain of *S. oryzae* on yellow split pea. In India, the pest was recorded for the first time to feed on red gram at Coimbatore. In the present investigation, the suitability of other split pulses was studied for its development in comparison to the population that occurs on sorghum in terms of F1 progeny, per cent weight loss and per cent grain damage.

MATERIALS AND METHODS

The two population of rice weevil, *S. oryzae*, was mass cultured on their respective hosts namely sorghum and red gram dal under laboratory. The development of population reared on split pulses was studied in comparison to that of sorghum. The experiment was laid out in a completely randomized design (CRD) with seven treatments viz., T1 = sorghum, T2 = split red gram dal, T3 = split chick pea dal, T4 = split black gram dal, T5= split green gram dal, T6= split roasted gram dal and T7= split lentil dal and each replicated three times. The experiment was conducted under room (temperature 26.5 -

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30.35°C, RH 65 - 73%) and controlled conditions (30°C, 70% RH). In a small plastic container with punctured lid, 100 grains from each material sample were placed. Each container was infested with 10 pairs of one week old adult rice weevils. Weevil sex was determined by rostra length and rostra pit discrimination (Reddy, 1951) and by abdominal tip shape (Qureshi, 1963). Separate set of containers each with 100 grains and 10 pairs of adult were maintained for observations on per cent grain damage, per cent weight loss and number of F1 progeny produced.

For F1 progeny study, released adults were separated from test materials via a #10 sieve and discarded after a week period and then the samples were replaced in their respective containers. Each container was carefully observed on daily basis, beginning on the 30th day of removal. Emerging progenies in each container were separated from the sample grain daily via #10 sieves, counted and then discarded. This process continued until there was no progeny emergence in all containers.

For both per cent weight loss and grain damage assessment the containers were maintained 60 days. Damaged and undamaged grains from the 100 grain samples in each container were separated manually using a magnifying glass at 15, 30, 45, and 60 days after release for both room and controlled conditions. Per cent grain damage was computed using the formula: Grain damage (%) = (number of damaged grains / total number of grains) × 100.

The per cent weight loss was calculated using initial and final grain weight measurements (60 day period). Weight Loss was worked out by using the formula (Adams and Schulton, 1978):

$$\text{Per cent weight loss} = (UND) - (DNU)/\ U\ (ND+NU) \times 100$$

Where, U- Weight of uninfested grains (g), NU- Number of uninfested grains (g), D- Weight of infested grains (g) and ND- Number of infested grains (g)

Percentage data were processed by arcsine and square root transformation wherever required. These processed values were subjected to an Analysis of Variance (ANOVA) test at 1% and 5% significance levels. The mean separation for treatments was done using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The data obtained on F1 progeny, per cent grain damage and per cent weight loss were analysed and used as parameters to determine the suitability of various split pulses for the *S. oryzae* population collected from red gram dal. Similar observations were also made on the population of *S. oryzae* developing on sorghum. The population of *S. oryzae* collected from red gram was found to develop on other split pulses namely green gram, chick pea, black gram, lentil and roasted gram. However among the spilt pulses, the number of F1 progeny emergence was significantly higher in red gram at both room and controlled conditions. The number of progenies emerged was 58.25 in red gram followed by green gram (52.75), chick pea (41.75), black gram (32.25), lentil (30.25) and fried gram (23.50) under room temperature. Similarly under controlled condition also the progeny emergence was significantly higher in red gram (43.00) and was on par with green gram (42.75) followed by chick pea (32.75), black gram (23.50), fried gram (22) and lentil (16.75) (Table 1). In case of sorghum, the number of F1 progeny produced was 72.75 and 57.5 at room and controlled temperature condition and it was significantly superior to all the treatments.

The per cent grain damage under room temperature condition was significantly higher in red gram (36.25) followed by 36.00 in green gram, 34.00 in chick pea, 27.00 in black gram, 24.25 in lentil and 20.00 in roasted gram on 15 days after release. However under controlled conditions, the percent grain damage observed 15 days after release was 35.00 in red gram, 34.25 in green gram, 27.00 in chick pea, 21.25 in black gram, 17.00 in fried gram and 12.00 in lentil respectively. The per cent grain damage under room temperature condition was 64.25 in red gram, 55.75 in green gram, 40.75 in chick pea, 27.75 in lentil and 19.75 in roasted gram on 30 days after release. Under controlled condition, the per cent grain damage at 30 days after release was significantly higher in red gram (59.25) followed by green gram (51.50), chick pea

(36.00), black gram (29.25), roasted gram (19.75) and lentil (14.75). At 45 days after release per cent grain damage was 84.25 and 73.0 in red gram and 76.25 and 69.0 in green gram under room and controlled condition. The per cent grain damage at 60 days after release was 93.50 and 92.75 at room temperature and 91.25 and 89.50 at controlled temperature in red gram and green gram and these two grains were at par with each other (Fig. 2). However, they significantly differed from other treatments during the entire study period. Per cent grain damage recorded in sorghum by the respective population during the period of study was significantly higher than that of pulses, ranging from 45.00 to 94.75 and 41 to 92.0 under room and controlled condition respectively (Table 2). Subedi et al. (2009) reported similar findings that the F1 progeny (138.8 adults) and per cent grain damage (18.75) were higher under room temperature (25 ± 3ºC) in case of polished rice compared to controlled condition. However, under controlled condition (30ºC, 70% RH) the per cent weight loss (14.11) was higher in polished rice compared to room temperature.

The present findings indicated that there was a highly significant positive correlation between F1 progeny, per cent weight loss and per cent grain damage in both room and controlled temperature. Similar findings were reported in few earlier works like *S. oryzae* damage in maize (Ahmad et al., 1986 and Navarro et al., 1978), *Trogoderma granarium* in wheat (Khattak et al., 2000), *Tribolium castaneum*, *T. granarium* and *Rhizopertha dominica* in wheat (Khan and Kulachi, 2002). During the experiment, *S. oryzae* population obtained from split red gram pulses completed their development on all the split pulses tested namely red gram, green gram, chick pea, green gram, black gram, roasted gram and lentil. However, red gram and green gram were found to be the most preferred host on the basis of progeny production, percent grain damage and weight loss. Coombs et al (1977) also reported the development of *S. oryzae* on grain legumes peas, lentils, green and black gram. However, progeny production, percent grain damage and weight loss by this population on split pulses was significantly lower than that of sorghum feeding population on sorghum. Compton et al (1998) reported that *S. zeamais* caused maximum per cent grain damage (85 - 93%) at 60 days after release in case of maize under room temperature condition. This was attributed to the susceptibility of the hosts and conducive climatic conditions (28°C and 65% RH).

The weight loss caused by storage insects depends on many factors such as insect species, environmental conditions, period of storage and the product itself (Howe, 1965). In the present study, the weight loss caused by *S. oryzae* feeding on pulses ranged between 4.10- 28.14 % under room temperature and 8.61- 37.15% under controlled condition, as compared to 32.94 and 34.76 % in sorghum. Koura and El-Halfawy (1972)

Table 1: The F1 progeny and weight loss in sorghum and split pulses due to *Sitophilus oryzae* L. infestation under room and controlled temperature (October-November 2023)

Treatments	*F1 Progeny (Mean)**		*Per cent weight loss (60 days after Release)*	
	Room temperature (R)	*Controlled temperature (C)*	*Room temperature (R)*	*Controlled temperature (C)*
Sorghum	72.75	57.50	32.94	34.76
Red gram	58.25	43.00	28.14	37.15
Chick pea	41.75	32.75	11.22	14.35
Black gram	32.25	23.50	7.94	11.76
Green gram	52.75	42.75	24.71	27.52
Roasted gram	23.50	22.00	4.70	8.61
Lentil	30.25	16.75	11.12	14.49
SEd	0.0784	0.1307	0.6286	0.7538
CD Value (0.05)	0.1630	0.2718	1.3072	1.5677

*Mean of three replications
Room Temperature (R) ranges from 26.5 to 30.35^0 C, RH ranges from 65 to 73% ©
Controlled Temperature (C) was 30^0 C, RH 70%

Table 2: The grain damage of sorghum and split pulses due to *Sitophilus oryzae* infestation under room and controlled temperature (October-November 2023)

Treatments	*Per cent grain damage*				*Per cent grain damage*			
	Room temperature (R)		*Controlled temperature (C)*		*Room temperature (R)*		*Controlled temperature (C)*	
	15th day	30th day	45th day	60th day	15th day	30th day	45th day	60th day
Sorghum	45.00	81.00	94.25	94.75	41.00	71.50	80.75	92.00
Red gram	36.25	64.25	84.25	93.50	35.00	59.25	73.00	91.25
Chick pea	34.00	40.75	64.75	83.25	27.00	36.00	63.00	81.75
Black gram	27.00	32.50	38.25	48.00	21.25	29.25	36.00	41.00
Green gram	36.00	55.75	76.25	92.75	34.25	51.50	69.00	89.50
Roasted gram	20.00	19.75	33.25	45.25	17.00	19.75	31.50	37.50
Lentil	24.25	27.75	38.75	53.25	12.00	14.75	16.00	31.00
SEd	0.6213	0.9182	1.0082	0.8835	0.7782	0.6926	0.7036	0.9220
CD Value (0.05)	1.2920	1.9096	2.0096	1.8374	1.6183	1.4404	1.4632	1.9175

Room Temperature (R) ranges from 26.5 to 30.35^0 C, RH ranges from 65 to 73% ©
Controlled Temperature (C) was 30^0 C, 70% RH

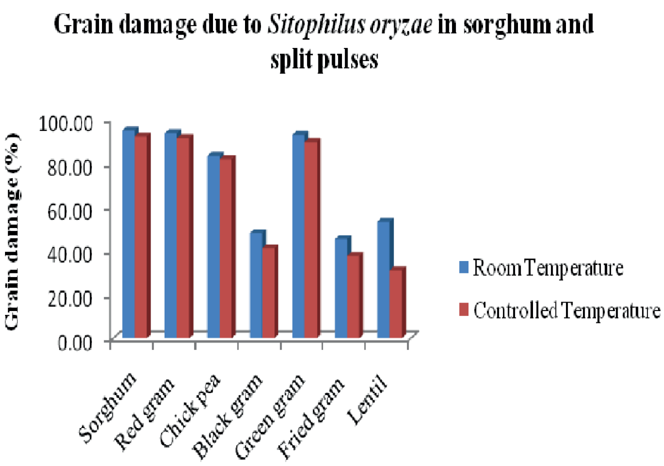

Figure 1: Grain damage due to *Sitophilus oryzae* in sorghum and split pulses at 60 days after release

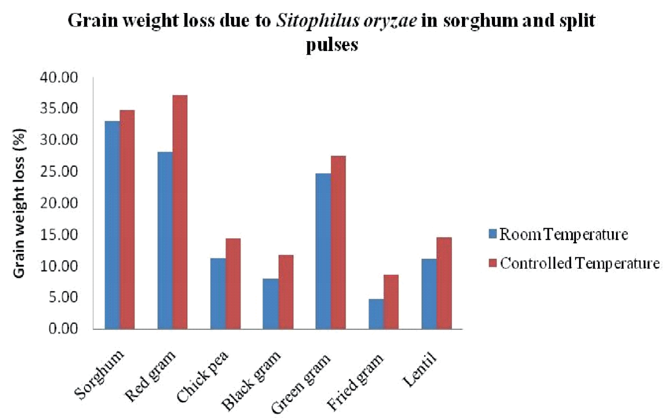

Figure 2: Grain weight loss due to *Sitophilus oryzae* in sorghum and split pulses at 60 days after release

reported about 79-81% weight loss in barley, 56-74% weight loss in rice and 36-40% weight loss in wheat due to *S. oryzae* and *S. granarius* infestation under natural conditions at 25°C and 70% RH. The loss recorded in grain sample weight due to the feeding of *S. oryzae* varied from 4 to 52% in different sorghum varieties during storage up to 9 weeks at 30°C and 72% RH (McMillian et al., 1981).

The variation in host preference is caused by physical characteristics as well as nutritional components and can be attributed as one reason for differential preference. Split pulses have a high nutritional value and rich in proteins viz., red gram (44%), green gram (48%), chick pea (38%), black gram (50%), lentil (52%) and roasted gram (30%). Apart from protein the amino acid content and composition also can influence the development of *S. oryzae* (Baker, 1976).

CONCLUSION

Based on the results observed on F1 progeny, per cent weight loss and per cent grain damage it is concluded the red gram and green gram dal were the most preferred among the six split pulses tested against *S. oryzae* strain population collected from red gram dal.

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