

ASSESSMENT OF QUANTITATIVE LOSSES IN DIFFERENT WHEAT VARIETIES DUE TO RICE WEEVIL (*SITOPHILUS ORYZAE* L.)

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ABSTRACT

A rapidly rising population and a shift in food preferences away from traditional cereals and towards wheat and wheat products are driving up wheat consumption. Storage pests, particularly *Sitophilus oryzae*, is one of the important insect pest, damages stored wheat grains, degrading the quality and quantity of the commodities by diminishing nutrition content and rendering them unfit for human use. To overcome such problems a study was undertaken to assess the quantitative losses caused by rice weevil in different wheat varieties during different storage periods so that to choose most resistant variety. This study was undertaken during 2018-2019 under laboratory conditions, different wheat varieties viz, VL 907, RSP 561, WH 1080, HD 3086, WH1105 were assessed for quantitative losses caused by rice weevil *Sitophilus oryzae*. The assessed parameters were adult emergence, per cent seed damage, per cent weight loss and per cent avoidable losses. Our investigation revealed that among the wheat varieties WH 1080 was found least susceptible with minimum number of progeny emergence (21.9), least seed damage (5.77%) and weight loss (1.50%) up to six months of storage period while as RSP 561 was highly susceptible with maximum number of progeny emergence (94.6), highest seed damage (69.3 %) and weight loss (23.6 %).

KEY WORDS : Wheat varieties, Quantitative losses, *Sitophilus oryzae* L., Storage

INTRODUCTION

Wheat (*Triticum aestivum* L.) is a rabi season crop that belongs to the Gramineae family. It is one of the most significant cereal crops in the world and is ranked second in terms of production among cereal crops (Datta *et al.*, 2009). Wheat is a staple food globally which accounts about 20% of total calorie consumption in the human diet (FAO,2018). India is the world's second-largest producer and consumer of wheat, with the major wheat-growing states being Uttar Pradesh, Madhya Pradesh, Punjab, Haryana, Bihar, Gujarat, and Rajasthan. The introduction of high yielding varieties has resulted in a phenomenal improvement in wheat production and productivity.

Post-harvest losses due to biotic and abiotic causes, as well as improper storage, account for around 10% of total grains in India. Wheat is attacked by a variety of insect pests (such as *Sitophilus oryzae*, *Rhyzopertha dominica*, *Trogoderma granarium*, and *Tribolium confusum*, as well as rodents) both in the field and in storage, resulting in quantitative and qualitative losses in post-harvest storage. Among these pests rice weevil, *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae) is one of the important insect that damages grains in storage (Nwaubani *et al.*, 2014). It is classed as a primary pest, cosmopolitan in nature and is known to infest sound cereal seeds (Hill, 1990). Chemical pesticides have traditionally been used to control pests in stored

grain, with phosphine being the most commonly used pesticide (Ribeiro *et al.*, 2003, Hossain *et al.*, 2014). However, the development of resistance to these agents makes it difficult to control *S. oryzae*, necessitating the use of alternative approaches (Lee *et al.*, 2001). Integrated pest management (IPM) is one of the eco-friendly approach of pest management (Ribeiro *et al.*, 2003). Plant resistance, a component of IPM, keeps pest population density below the economic damage threshold without increasing farmer costs, and it's compatible with other pest management methods (Seifi *et al.*, 2013). Insect resistance in stored grains can take the form of antibiosis, which occurs when a grain trait affects the biology of the insect, increasing mortality while lowering lifetime and reproduction of insects. Also antixenosis, on the other hand, that changes insect behaviour, resulting in decreased eating and oviposition (Lara, 1991; Smith, 2005).

MATERIALS AND METHODS

The following five wheat varieties were obtained from the Wheat Breeder, Mega Seed Project, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu for the purpose to study varietal susceptibility/quantitative losses caused by *S. oryzae* (L.) The varieties assessed were VL 907, RSP 561, HD 3086, WH 1105 and WH 1080.

Procedure: The wheat seeds of each variety were properly cleaned to remove the fractions or insects, after that the seed material was sealed in polythene bags to kept the seed material air tight conditions, Later, these seeds of each variety were kept in deep freezer at -20 °C for 72 hours to make them free from insects and after removing from the freezer these seeds were conditioned at least for a week,



Damaged seeds by *sitophilus oryzae*

maintaining temperature $28 \pm 1^{\circ}$ C and relative humidity 70 ± 5 per cent in Biological Oxygen Demand (BOD) incubator. Initial weight was recorded by taking 500gm sound seeds of properly conditioned variety and weighed accurately by using electrical automatic balance; three such replications were weighed. After weighing these grains were transferred to 1 kg plastic jars and 20 freshly emerged weevils were released. The mouth of each jar was covered with muslin cloth and the muslin cloth was tightened with rubber bands and number of holes was made on the lid of the jars to facilitate proper aeration and ventilation (plate 5). Then, these jars were kept in BOD incubator by maintaining the temperature $28 \pm 1^{\circ}$ C and relative humidity 70 ± 5 per cent and each jar was carefully observed for recording below mentioned observations for 2, 4 and 6 months after release of parent weevils.

Adult emergence: The seeds were examined daily from 25th day after release of weevils for first generation of rice weevil. Newly emerged adults in each jar were counted and removed to know further emergence at 2, 4, and 6 months interval.

Per cent weight loss and seed damage: The final weight was recorded after removal of all exuviae and pupal cases from the damaged material in 2, 4 and 6 months interval. For per cent seed damage and per cent weight loss, a sample of 100 seeds were selected randomly and number of damaged and healthy seeds were counted and separated (Plate 6 and Plate 7). The per cent seed damage and weight loss were calculated by using the following formulae given. The experimental observations were recorded *vide supra* (3.2).

Per cent avoidable loss: On the other hand, the percent avoidable loss in a particular variety with reference to least susceptible variety with minimum loss in weight caused by *S. oryzae* were calculated by using the following formula.

$$\text{Per cent avoidable loss in a Particular susceptible variety} = \frac{\text{ALWSV} - \text{ALWLSV}}{\text{ALWSV}} \times 100$$

Whereas,

ALWSV= Average loss in weight (gm) of a susceptible variety

ALWLSV= Average loss in weight (gm) of least susceptible variety

Statistical Analysis: The data obtained from the experiments were statistically analyzed on factorial CRD with SPSS 14.0 version software. All the

characters under this research were assessed by using Duncan’s multiple range test (DMRT).

RESULTS AND DISCUSSION

Adult emergence, Per cent seed damage, Per cent weight Loss and Per cent avoidable loss.

In the present investigations it was observed that adult emergence increased with increase in storage period. Behaviour of different wheat varieties towards successful emergence of adults differed significantly. Minimum numbers of weevils emerged from varieties was in the order of WH 1080 (21.9)>HD 3086(27.6)>VL 907(41.6)>WH 1105 (72)>RSP 561 (94.6). It was inferred that the maximum adult emergence was noticed on susceptible varieties, i.e. RSP 561 weevil emerged 77.6, 89.3 and 117 in 2, 4 and 6 months after release of 20 weevils at the beginning of storage. The minimum adult emergence was noticed on most resistant varieties observed in the present result, i.e. WH 1080 weevil emerged 8.66, 20.6 and 36.6 in 2, 4 and 6 months. The present investigations fare in accordance with those of Sudhakar and Pandey (1982) and Tiwari and Sharma (2002) who found similar variation in adult emergence on wheat varieties indicates the susceptibility/resistance of that variety. Similarly, Sharma (1984) reported that the maximum and minimum number of adult emergence of this pest on different varieties of wheat. Similar observations have been made by Patel (2006), Yadav and Bhargava (2008) and Verma *et al.*, (2012) which are in conformity with the present findings

The percentage of damaged seeds and loss in weight of different wheat varieties recorded after six

months of storage due to infestation of the rice weevil ranges from 5.77% to 69.3% and 1.50% to 23.6% respectively, being maximum damaged seeds and weight loss in RSP 561, while minimum seed damage and weight loss in WH 1080. These results are in confirmation with Rai and Singh (1979) who found loss in grain weight from 1.63 to 10.73 per cent in different wheat varieties by the attack of *S. oryzae*. The present results are in line with Yadev *et al.* (2008) and Arve *et al.* (2014) who observed that the maximum grain damage and loss in weight were found in highly susceptible varieties of wheat. Gupta *et al.* (1999) also found the grain damaged and loss in weight ranging from 11.66 to 75.33 and 8.71 to 41.77 per cent in different maize varieties due to infestation of *S. oryzae* support the present findings.

Per cent avoidable losses after two month of storage were calculated with reference to least susceptible variety. Avoidable loss was recorded in RSP 561 (95.9%) followed by WH 1105 (87.0 %), HD 3086 (74.4%) and VL 907 (62.9 %). The maximum avoidable loss was observed in RSP 561 (95.9 %)

Table 2. Avoidable losses by *S. oryzae* in different wheat varieties during Seed storage periods.

Varieties	Storage duration			Mean
	2 Month	4 Month	6 Month	
VL 907	62.9	87.5	84.5	78.3
RSP561	95.9	97.3	88.8	94.3
HD 3086	74.4	81.0	2.19	52.5
WH 1105	87.0	96.0	79.7	87.5
WH 1080	0.00	0.00	0.00	0.00
Mean	64.0	72.3	51.0	

*Data based on three replications.

Table 1. Per cent weight loss by *S. oryzae* in different wheat varieties during Seed storage periods.

Varieties	Storage duration			Mean
	2 Month	4 Month	6 Month	
VL 907	2.16(1.47)	4.81(2.19)	20.2(4.49)	9.05(3.00)
RSP 561	19.6(4.42)	22.9(4.78)	28.1(5.30)	23.6(4.85)
HD 3086	3.13(1.76)	3.17(1.78)	3.19(1.78)	3.31(1.82)
WH 1105	6.19(2.48)	15.3(3.91)	15.4(3.92)	12.3(3.51)
WH 1080	0.80(0.89)	0.60(0.77)	3.12(1.76)	1.50(1.22)
Mean	6.39(2.52)	9.38(3.06)	14.0(3.74)	
Factors	F value		P value	
Varieties	166.4		.000	
Storage	52.40		.000	
Varieties*storage	12.49		.000	

* Data based on three replications.

**Figures in the parenthesis are Square root transformed.

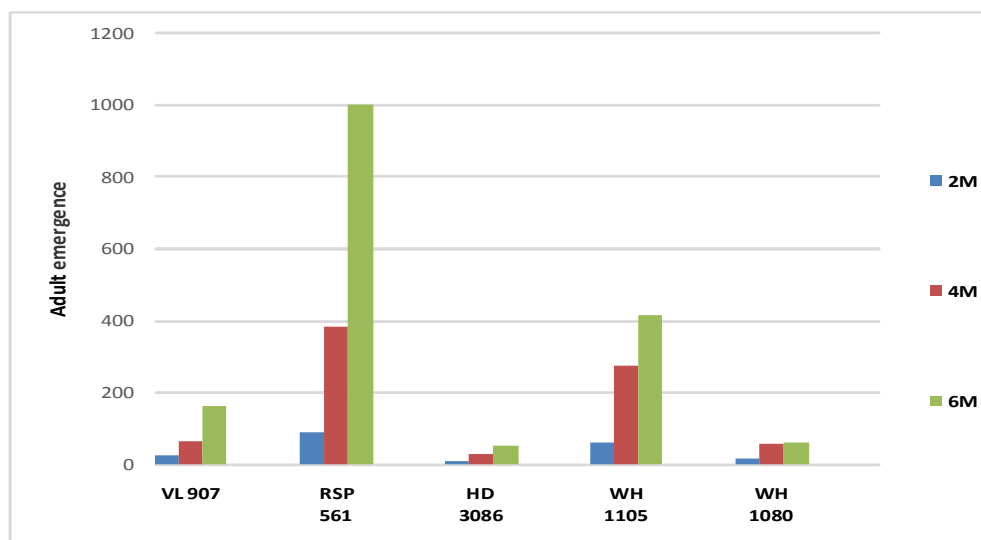


Fig. 1. Adult emergence of *S. oryzae* in different wheat varieties during Seed storage period

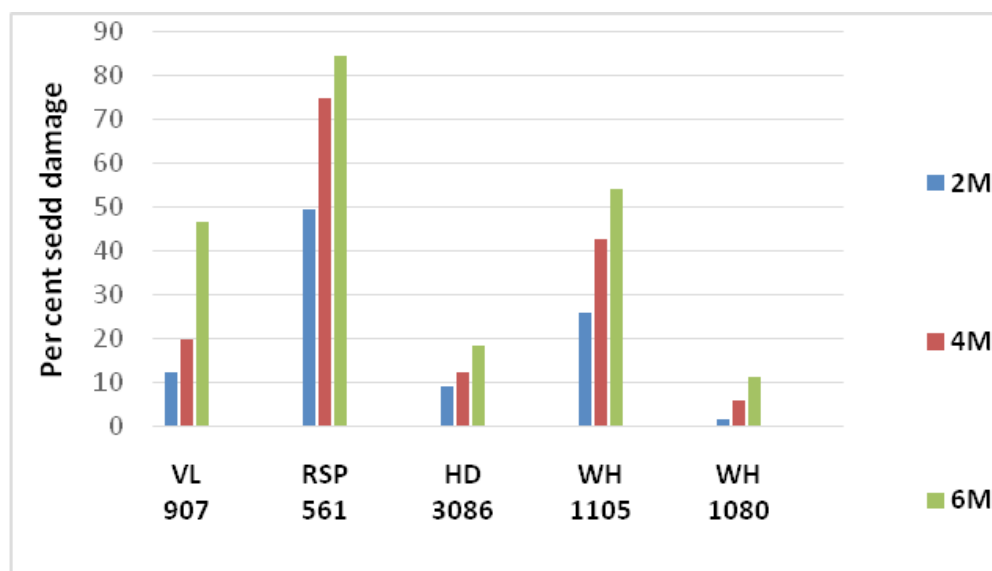


Fig. 2. Per cent seed damage by *S. oryzae* in different wheat varieties during two, four and six months of storage

while minimum in WH 1080 (0.00%). Similarly, after four month of storage the percent avoidable losses was recorded in RSP 561 (97.3%) followed by WH 1105 (96.0%), VL 907 (87.5%) and HD 3086 (81.0%). There is little change in trends after six month of storage, maximum avoidable loss was recorded in RSP 561 (88.8%) followed by VL 907 (84.5%), WH 1105 (79.7%) and HD 3086 (2.19%). Almost same trends were observed in Mean average avoidable losses observed in RSP 561 (94.3 %) followed by WH 1105 (87.5 %), VL 907 (78.3 %) and HD 3086 (52.5 %). Similar investigation was done by Yadav *et al.* (2018a) on qualitative losses in different varieties of

wheat caused by the infestation of *S. oryzae* who reported Raj 4037, Raj 3765 and Raj 4083 were found less susceptible while Raj Molyarodhak-1, Raj 4238, Raj 4079 and Raj 4120 were moderately susceptible, whereas, Raj 1482, Raj 3077 and Raj 3777 were among the most susceptible varieties. In a similar experiment, Yadav *et al.* (2018b) reported that the percentage of damaged grains and loss in weight of different wheat varieties due to infestation of the weevil from 29.00 to 58.77 and 8.33 to 16.29, respectively, being maximum damaged grains and weight loss in Raj 1482, while minimum grain damage and weight loss in Raj 403.

From the foregoing results it was concluded that none of the wheat varieties was found completely resistant to *S. oryzae*. However, on the basis of avoidable losses HD 1080 was suitable for storage for further seed purpose among all the tested wheat. The remaining varieties showed intermediary behaviour.

CONCLUSION

Results recorded on different parameters such as adult emergence, seed damage, weight loss and avoidable loss revealed that variety WH 1080 of wheat is least preferred by *S. oryzae* over other varieties. By using resistant varieties farmers can save their stored seeds, health, environment and increase their capital.

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