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# STUDIES ON THE QUALITY OF WHEAT GRAIN INFLUENCED BY THE INFESTATION OF STORED GRAIN PESTS DURING STORAGE

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This paper gives a brief account of certain physiological, mycological and biochemical changes in wheat (*Triticum aestivum L.*) grains due to infestation of rice weevil (*Sitophilus oryzae L.*) and lesser grain borer(*Rhizopertha dominica F.*) during storage. It was found that the incidence percentage of fungal flora,total nitrogen, uric acid, nitrogen and free fatty acid of grains increased considerably at the end of third and fourth month of storage. The 100-grain weight, germinability, non-reducing sugars, reducing sugars and total water soluble sugars decreased with the increase in insect infestation as compared to control.

**Keywords**: Infestation; Stored grain pest; Storage, Wheat.

## Introduction

Rice weevil (*Sitophilus oryzae L.*) and lesser grain borer(*Rhizopertha dominica F.*) are major stored grain insects which attack the stored cereal grains and inflict qualitative and quantitative losses, deteriorating and decreasing the solubility of the proteins.[1,2] The stored grain insect pests infestation also encourage fungus growth by increasing the moisture content of the grains which decreased the viability of the grains and the bread making quality is lowered.[3,4] The present work was carried out to investigate the effect of infestation by the rice weevil and lesser grain borer at different levels of initial population on the quality of wheat grains.

## Materials and Methods

Wheat (*Triticum aestivum* L.CV.HD-2189) was cleaned and sieved with 3.5 mm diameter sieve to remove small fractions of grains or insects, if any.Wheat grains were then disinfested in small quantities (500 gm) in glass jars by heating in an oven at $60^0$C for four hours.[5] The moisture content of grains was adjusted at 14 per cent by adding water directly as per formula of Harein and Soderstrom.[6] One day old adults of each species was used for pairing and releasing into the grains kept in glass jars (15 cm x 10 cm). There were five replications. Grains were stored for four mounths under laboratory conditions. Insects were released in grains at two,four and eight pair per 500 gm wheat for initial infestation.

Four identical experimental sets were prepared and observations were taken at interval of one month. On due date of observation, wheat grains of the particular set were sieved thoroughly with a 3.5 mm

diameter sieve, to separate frass and insects. The insects along with frass were kept at $5^0$C in an incubator to be counted later on. The insects were separated from the frass and then exposed to $100^0$C in an oven for 10 minutes in thin layer in petri dishes to kill them so as to facilitates their counting.A representative sample of grain from each repeat was taken for quantitative analysis. The total nitrogen, uric acid nitrogen, total reducing sugars; non-reducing sugars and free fatty acid from the grains were determined by the methods of Mickenzie and Wallac[7], Venkatrao *et al.*[8] Brown and Guenther[10] respectively.

The germination medium used was rolled towel paper at temperature 20±1 $^0$C and R.H 85%. Germination was tested in quadruplicate with 100 grains in each replication. The germination percentage was evaluated on the value for per cent normal seedlings[11]. The fungalflora of the grains were detected by the standard moist blotter and agar medium techniques as prescribed by International rules for seed testing[12]. The different types of fungal growth on the seed were expressed in percentage

**Results and Discussion**

The date presented in Table 1 indicated that the 100-grain weight of wheat decreased with increase in population of *S. oryzae* and *R. dominica* and storage periods. The 100-grain weight decreased with increasing infestation of both stored grain insects. Since the stored grain insects have been eaten off major portion of the endosperm which leads to reduction in weight of the grains and inturn affects the seedling establishment because of lack of stored food and is in confirmity with the findings of Narayanaswamy.[13] The germination follow the same trend of 100-grain weight. It was highest in control and decreased with increase in population of both stored grain insect and storage periods. This might be due to germ of grains is infested by stored grain pests, grains fails to germinate and thus grain germinability decreases with an increase of grain infestation.[14]

The fungi *Alternaria* sp., *Aspergillus* sp., *Curvularia* sp., *Drechslera* sp., *Fusarium* sp., *Penicillium* sp. and *Rhizopus* sp. were found associaed with different categories of grains. The incidence percentage of fungal flora increase with increase in population of both stored grain insects and storage periods. *Aspergilli* was predominant over all other fungi. Dominance of *Aspergilli* on stored grain has been reported earlier by Charjan and Tarar.[15] The storage fungi directly damage the grain germ and indirectly enhance the multiplication of storage insects.[16]

Table 1 rervealed that during first and two months of storage the total nitrogen content of wheat grains was found to decrease due to infestation of both species; and with higher insect population as compared with insect free samples. However, during third and fourth months of storage there was slight increase in total nitrogen content. This might be due to the excreta of these insects.

The uric acid nitrogen and free fatty acid was formed to increase with increase in population of *Sitophilus oryzae* and *Rhizopatha dominica* (Table 1). Maximum, increase of this nitrogen and free fatty acid was found in wheat samples infested by *S. oryzae* followed by *R. dominica.* Since *S. oryzae* and *R. dominica*

**Table 1.** Changes in grain quality of wheat due to infestation of different insect population during storage.

| Grain quality parameters | *Sitophillus oryzae (L)* | | | *Rhizopertha dominica (F.)* | | |
|---|---|---|---|---|---|---|
| | 2 pairs | 4 pairs | 8 pairs | 2 Pairs | 4 Pairs | 8Pairs |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| *100 grain weight (g)* | | | | | | |
| Control | 11.2 | 11.2 | 11.2 | 11.2 | 11.2 | 11.2 |
| First month | 10.9 | 10.4 | 10.3 | 10.8 | 10.6 | 10.4 |
| Second month | 9.2 | 8.7 | 8.2 | 9.8 | 9.6 | 9.2 |
| Third month | 8.4 | 7.4 | 6.8 | 8.7 | 8.2 | 7.5 |
| Fourth month | 7.2 | 6.2 | 5.4 | 7.9 | 7.2 | 6.5 |
| Germination (%) | | | | | | |
| Control | 98 | 98 | 98 | 98 | 98 | 98 |
| First month | 90 | 85 | 81 | 92 | 89 | 86 |
| Second month | 84 | 76 | 68 | 88 | 80 | 71 |
| Third month | 70 | 59 | 41 | 75 | 65 | 46 |
| Fourth month | 45 | 24 | 5 | 50 | 34 | 16 |
| *Incidence of fungi (%)* | | | | | | |
| Control | 21.2 | 21.2 | 21.2 | 21.2 | 21.2 | 21.2 |
| First month | 39.6 | 46.5 | 59.2 | 31.6 | 42.4 | 51.6 |
| Second month | 48.8 | 69.6 | 81.6 | 42.8 | 60.4 | 75.4 |
| Third month | 69.7 | 91.7 | 136.2 | 65.4 | 79.6 | 126.4 |
| Fourth month | 96.2 | 122.4 | 171.6 | 81.8 | 106.2 | 151.5 |
| Total Nitrogen *(mg/100 g grain)* | | | | | | |
| Control | 2102 | 2102 | 2102 | 2102 | 2102 | 2102 |
| First month | 2094 | 2094 | 2086 | 1976 | 1980 | 1964 |
| Second month | 2056 | 1991 | 1973 | 2096 | 2092 | 2037 |
| Third month | 2995 | 1902 | 1877 | '1912 | 1998 | 1992 |
| Fourth month | 1888 | 1827 | 1803 | 1909 | 1886 | 1892 |
| Uric acid nitrogen *(mg/100g grain)* | | | | | | |
| Control' | 4.13 | 4.13 | 4.13 | 4.13 | 4.13 | 4.13 |
| First month | 8.01 | 16.72 | 21.25 | 5.72 | 9.42 | 10.46 |
| Second month | 30.25 | 40.25 | 45.13 | 18.67 | 29.11 | 30.25 |
| Third month | 100.50 | 112.65 | 131.82 | 35.42 | 71.25 | 78.60 |
| Fourth month | 151.65 | 172.13 | 205.25 | 72.50 | 90.13 | 112.20 |
| *Reducing sugars (mg/100 g grain)* | | | | | | |
| Control | 3267 | 3267 | 3267 | 3267 | 3267 | 3267 |
| First month | 3092 | 3000 | 2814 | 3202 | 3187 | 2946 |
| Second month | 2576 | 1942 | 1618 | 2048 | 1889 | 1697 |
| Third month | 1655 | 924 | 819 | 1567 | 1347 | 1229 |
| Fourth month | 615 | 587 | 539 | 1104 | 986 | 912 |
| Free fattyacid (oleic %) | | | | | | |
| Control | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 | 8.5 |
| First month | 9.9 | 9.8 | 10.4 | 9.2 | 9.5 | 9.9 |
| Second month | 10.7 | 10.9 | 11.8 | 11.2 | 11.7 | 11.9 |
| Third month | 11.4 | 11.9 | 13.3 | 12.1 | 12.9 | 12.8 |
| Fourth month | 13.9 | 14.2 | 14.7 | 12.8 | 13.7 | 14.2 |
| *Non reducing sugars (mg/100 g grain)* | | | | | | |
| Control | 1884 | 1884 | 1884 | 1884 | 1884 | 1884 |
| First month | 1676 | 1619 | 1554 | 1841 | 1821 | 1812 |
| Second month | 946 | 941 | 901 | 1126 | 1104 | 1089 |
| Third month | 719 | 712 | 726 | 1002 | 998 | 1019 |
| fourth month | 527 | 596 | 614 | 816 | 821 | 842 |

adults have longer life, uric acid nitrogen was found to be highest with higher population. Similar observations have been made by Subramanyam *et al.*[2]

The non-reducing sugars, reducing sugars and total water soluble sugars decreased in grains infested by both the species and with the higher population of the insects as compared to the control (Table 1). The damage done by *Rhizopatha dominica* was found to be minimum as compared to *Sitophilus oryzae*. However, there was no correlation between the trend of the decrease of these sugars and the population of the insects in the both species that may be due to the hydrolysis of the starch (polysaccharides) into mono and disaccharides and then into the reducing sugars which can be easily consumed by the insects. Pingale and Sharma *et al*[17] also observed that in insect damaged wheat grain reducing sugars content is relatively greater after period of storage.

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