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## Qualitative losses in different varieties of wheat caused by the infestation of *Sitophilus oryzae*

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### Abstract

Investigations were carried out on qualitative losses in different varieties of wheat caused by the infestation of *Sitophilus oryzae* during 2015 and 2016 at S.K.N. College of Agriculture, Jobner. Out of 10 varieties screened on the basis of physico-chemical characters against this insect, 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.

**Keywords:** *Sitophilus oryzae* L., wheat, physico-chemical characteristics

### Introduction

Wheat (*Triticum aestivum* L.) belongs to family Gramineae, is a staple food in the world and said to be originated from South Western Asia. Wheat is used in various forms viz., *Chapaties*, *Dalia*, *Halva*, sweet meat etc. and is consumed by more than one thousand million human beings. In India, post harvest losses caused by the unscientific storage, rodents, insects, microorganism, moisture etc., account for about 10 per cent <sup>[1]</sup>. It is a well known fact that food constituent and play a vital role in survival and reproduction potential of the insects. Although almost all the varieties of wheat grown in the country are infested by stored grain pests but the extent of damage is influenced by the physical and chemical characters of the host variety. The damage potential of the rice weevil has been the subject of considerable research mainly on the relative preference in different stored products and among the varieties of the same product. Keeping this in view an attempt has been made to study the growth and development of this pest on some promising wheat varieties.

### Materials and Methods

#### Maintenance of insect culture

To maintain the stock culture of *S. oryzae*, the sound and healthy wheat grains were cleaned and sieved to remove the fractions of grains or insects if any. The grains were sterilized at  $60 \pm 5$  °C for eight hours in order to eliminate both apparent and hidden infestation of insects and mites, if any. These grains were conditioned at least for a week in an incubator maintaining  $27 \pm 2$  °C and  $70 \pm 5$  per cent relative humidity to raise their moisture content. All the experiments were carried out in Completely Randomized Design with three repetitions.

#### Grain size

Grain size was determined by the water displacement method <sup>[2]</sup> wherein known volume of water taken in a measuring cylinder (10 ml capacity) and then 100 grains were introduced. The increase in volume gave volume of 100 grains. The process was repeated thrice to get a mean volume of 100 grains which were used as an index of grain size of a variety.

#### Moisture content

The moisture content in the collected samples was determined with the help of MAC digital moisture meter.

#### Qualitative losses

Nutritional changes of the infested grains induced by an infestation of *S. oryzae* larvae were studied for carbohydrates and proteins. For this purpose, infested wheat samples were cleaned

and sieved to remove insect body parts. cleaned grain samples of healthy and infested grains in triplicate were taken for determination of carbohydrates and proteins by following standard methods.

#### Determination of total carbohydrates

Total carbohydrates were estimated by using anthrone reagent [3].

Weighed sample (100 mg) was taken in a tube and hydrolyse with 5 ml of 2.5 N-HCl by keeping it in a boiling water bath for three hrs and cooled to room temperature. It was neutralized with solid sodium carbonate until the effervescence ceases. The volume was made to 100 ml with distilled water and centrifuged. The supernatant was collected and 0.5 -1 ml aliquots were taken for analysis. The standards were prepared by taking 0.2, 0.4, 0.6, 0.8 and 1 ml of the working standard in separate tubes. The volumes in all tubes were made to 1 ml including the sample tubes by adding distilled water. The tube containing 1 ml distilled water served as control. 4 ml of anthrone reagent was added to each tube and the tubes were kept for eight minutes in a boiling water bath. The tubes were cooled rapidly and read the green to dark green colour at 630 nm. Finally standard graph was drawn by plotting concentration of the standard on the X-axis verses absorbance on the Y-axis and from the graph amount of carbohydrate present in the samples were calculated.

$$\text{Amount of carbohydrate} = \frac{\text{Mg of glucose}}{\text{Volume of test sample}} \times 100$$

#### Determination of proteins

Proteins were estimated by using Kjeldahl method [4]. 100 mg of sample in a digestion tube was weighed. A pinch of catalyst mixture ( $K_2SO_4 + HgO + CuSO_4$ ) and 2 ml of concentrated sulphuric acid was added to this. The sample was digested for about half an hour till it became colourless. After cooling, little distilled water was added. A 100 ml conical flask was placed containing 5 ml of 4% boric acid solution with few drops of mixed indicator; the tip of the condenser should dip below the surface of the solution. 10 ml of NaOH-sodium thiosulphate solution was added to the test solution. Distillation was done for 5-7 minutes and ammonia liberated was collected and trapped in boric acid. This solution was titrated with 0.02N sulphuric acid till colour change appeared. A blank was run with equal amount of distilled water. The liberated N content was calculated by using following formula.

$$N \text{ g/kg} = \frac{HCl \text{ in ml} \times \text{Normality of HCl} \times 14.04}{\text{Weight of Sample (g)}}$$

Protein (%) is calculated multiplying by 6.25.

#### Results and Discussion

To determine the various physico-chemical characters related to different wheat varieties for susceptibility to *S. oryzae*, the following physico-chemical characters viz., grain size, moisture, carbohydrates and protein contents of fresh and infested grains were studied.

##### Grain size (Table 1)

The size of grains of each variety was recorded by taking the mean volume of 100 wheat grains in ml. There was no significant difference were observed among them. The

varietal variation in grain size ranged from 1.8 to 2.9 ml. The smallest grain size was in Raj-4037 (1.8 ml), followed by Raj-3765 (2.0 ml), Raj-4083 (2.1 ml), Raj-Molyarodhak-1 (2.2 ml) and Raj-4238 (2.3 ml). The highest grain size was observed in Raj-1482 (2.9 ml), followed by Raj-3077 (2.7 ml), Raj-3777 (2.6 ml), Raj-4120 (2.5 ml) and Raj-4079 (2.4 ml), respectively. The results are in confirmation with the work of Ram and Singh [2] and Yadav and Bhargava [5] who reported positive correlation of grain size with weevil susceptibility. Rao and Sharma [6] showed that size had great influence on the varietal variations of the grain to rice weevil susceptibility was associated with a corresponding increase in weevil susceptibility of the grains, which is in accordance with the present findings.

**Table 1:** Physico-chemical characters of different wheat varieties\*

Varieties	Size of 100 grains (ml)	Moisture content (%)
Raj-3765	2.0	10.85
Raj-3777	2.6	12.00
Raj-4037	1.8	10.56
Raj-4079	2.4	11.85
Raj-4083	2.1	11.20
Raj-4120	2.5	11.90
Raj-4238	2.3	11.75
Raj-Molyarodhak-1	2.2	11.45
SEm±	0.09	0.20
CD at 5%	0.27	0.58
CV %	1.83	1.72

\*Data based on three replications

##### Moisture content (Table 1)

The moisture content of grains in different wheat varieties ranged from 10.56 to 12.60, being maximum in Raj-1482 and minimum in Raj-4037. The lowest moisture content was found in Raj-4037 (10.56%) which was at par with Raj-3765 (10.85%), Raj-4083 (11.20%) and Raj-Molyarodhak-1 (11.45%). The highest moisture content was observed in Raj-1482 (12.60%), which was at par with Raj-3077 (12.25%), Raj-3777 (12.00%), Raj-4120 (11.90%), Raj-4079 (11.85%) and Raj-4238 (11.75%), respectively. The present findings confirms with the work of Yadav and Bhargava [5] and Verma *et al.* [7] who reported that the moisture is highly significantly positively correlated with weight loss due to *S. oryzae*. Somewhat similar results were also observed in other cereals by Gupta *et al.* [8] and Uttam *et al.* [9] recorded that the varieties with higher moisture content are most susceptible in comparison to the lower moisture content in different varieties of maize and barley, respectively and their views are in accordance with present findings.

##### Carbohydrate (Table 2)

Findings of the present investigations enunciated a negative effect of *S. oryzae* infestation on the carbohydrate contents of wheat grains. Minimum reduction to the tune of 2.66 per cent carbohydrate was observed in Raj-4037, while maximum reduction 7.17 per cent in Raj-1482. Ascending order of carbohydrate reduction in different varieties: Raj-4037 (2.66%), Raj-3765 (2.88%), Raj-4083 (3.24%), Raj-Molyarodhak-1 (4.49%), Raj-4238 (4.81%), Raj-4079 (5.03%), Raj-4120 (5.31%), Raj-3777 (5.79%), Raj-3077 (6.79%) and Raj-1482 (7.17%), respectively. The results are in conformity with the findings of Wakil *et al.* [10] who reported that the negative correlation was exhibited between carbohydrate contents and insect damage. The results are also in line with the findings of previous workers such as Arve *et*

al. [11] who observed a significant decrease in carbohydrate content of wheat grains due to attack of rice weevil.

**Table 2:** Physico-chemical characters of different wheat varieties\*

Variety	Carbohydrate			Protein content		
	Fresh grain	Infested grains	Per cent decrease	Fresh grain	Infested grains	Per cent increase
Raj-1482	71.97	66.81	7.17	12.03	12.35	2.66
Raj-3077	70.35	65.57	6.79	12.67	12.99	2.53
Raj-3765	68.40	66.43	2.88	12.14	12.33	1.57
Raj-3777	69.92	65.87	5.79	12.43	12.72	2.33
Raj-4037	68.13	66.32	2.66	11.78	11.94	1.36
Raj-4079	70.59	67.04	5.03	11.92	12.14	1.85
Raj-4083	69.53	67.28	3.24	11.49	11.67	1.57
Raj-4120	71.89	68.07	5.31	11.82	12.07	2.12
Raj-4238	68.61	65.31	4.81	11.66	11.87	1.80
Raj-Molyarodhak-1	70.12	66.97	4.49	11.45	11.65	1.75
SEm±	1.39	1.03	0.33	0.42	0.47	0.14
CD at 5%	4.14	3.06	0.98	1.25	1.41	0.40
CV %	4.25	3.27	4.61	3.62	4.04	3.01

\*Data based on three replications

### Protein content (Table 2)

The data revealed that the protein content in different wheat varieties increased due to infestation of *S. oryzae*. The highest increased percentage of protein was observed in the variety Raj-1482 (2.66%), followed Raj-3077 (2.53%), Raj-3777 (2.33%) and the later variety was also at par with Raj-4120 (2.12%). The lowest increase in percentage of protein was noted in Raj-4037 (1.36%), which was at par with Raj-3765 (1.57%) and Raj-4083 (1.57%). Rest of the varieties viz., Raj-Molyarodhak-1 (1.75%), Raj-4238 (1.80%), Raj-4079 (1.85%) and Raj-4120 (2.12%) were noted with medium percentage increased. From the observation, it was obvious that increase in protein percentage was maximum in susceptible varieties of wheat grains due to infestation of *S. oryzae* and vice-versa. Bindra and Kumari [12] and Singh and Agrawal [13] reported that the protein percentage was low in

resistant varieties as compared to susceptible ones due to *S. oryzae*. The results obtained by Rao and Sharma [6] and Yadav and Bhargava [5] were also in support the present study, who found the increase of protein in damaged grains due to *S. oryzae*. Gupta *et al.* [14] also observed similar increase in protein percentage was maximum in susceptible varieties of maize grains due to infestation of this pest and vice-versa, support the present findings.

### Correlation studies on physico-chemical characters of wheat varieties

The various physico-chemical characters of wheat grains were correlated with the infestation of *S. oryzae* to know the relationship between the physico-chemical characters and damaged grains and weight loss in grains. The correlation and their regression equations are given in table 3.

**Table 3:** Regression equations and correlation coefficient among the different physico-chemical characters, population and infestation of wheat

X Variable	Y Variables	r	Regression equations
Grain size	Damaged grains	0.977**	Y=1.032+0.0316X
	Loss in weight	0.974**	Y=0.979+0.111X
Grain moisture	Damaged grains	0.943**	Y=9.267+0.0571X
	Loss in weight	0.943**	Y=9.164+0.200X
Carbohydrate	Damaged grains	-0.965**	Y=-1.168+0.144X
	Loss in weight	-0.953**	Y=-1.353+0.498X
Protein	Damaged grains	0.985**	Y=0.250+0.407X
	Loss in weight	0.976**	Y=0.192+0.142X

r = Correlation co-efficient; \* Significant at 5 per cent, \*\* Significant at 1 per cent

The correlation of grain size, grain moisture and protein contents of the grains were observed to be significantly positive with the infestation of *S. oryzae*. Thus, the population and infestation of the pest increased with the increase in moisture and protein contents. Ram and Singh [2] and Yadav and Bhargava [5] reported a positive correlation of grain size with weevil susceptibility with some aberrations to this relationship and reported that wheat varieties having more grain size differ in weevil susceptibility, support the present findings. Similarly, Rao and Sharma [6] also reported that the grain size was positively correlated and highly significant with mean progeny weevil emergence. Yadav and Bhargava [5] and Verma *et al.* [7] reported that the moisture is highly significantly positively correlated with grain damage and loss in weight.

In the present study, the relationship of protein content was found to be significant having positive correlation with the

damaged grains and loss in weight. Yadav and Bhargava [5] reported a positive correlation of protein with a maximum index of susceptibility, percentage of loss in weight and damage grains, support the present findings. Similarly, Wakil *et al.* [10] and Arve *et al.* [11] also reported the positive correlation among the damaged wheat and protein.

The carbohydrate had a significantly negative correlation with grain damage and weight loss. Thus, it is clear that the population and infestation of the pest increased with the carbohydrate content decreased. The results are in conformity with the findings of Wakil *et al.* [10] who reported that the negative correlation was exhibited between carbohydrate contents and insect damage. The results are also in line with the findings of previous workers such as Arve *et al.* [11] who observed a significant decrease in carbohydrate content of wheat grains due to attack of rice weevil.

### Conclusion

Basis of different parameters, comparatively 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.

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