Indian Journal of Applied Entomology **26**(1) : 23–27 (2012)

ESTIMATION OF QUANTITATIVE AND QUALITATIVE LOSSES CAUSED BY INSECT PESTS IN STORED WHEAT IN WESTERN RAJASTHAN

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ABSTRACT

Investigation on the quantitative and qualitative losses caused by insect pests in stored wheat in three districts of Western Rajasthan revealed that the wheat is infested by *Sitophilus oryzae* Linn., *Rhizopertha dominica* (Fab.), *Trogoderma granarium* Everts., *Sitotroga cerealella* (Oliver), *Tribolium castaneum* (Herbst). Of which, *R. dominica* and *T. granarium* caused maximum damage while, *S. cerealella* was found to inflict minimum damage. During June–July *T. granarium* followed by *R. dominica* was found most prominent. The population of *T. granarium* was 8.6, 6.8 and 3.2 insects/ 100 g wheat in Pali, Jodhpur and Jalore districts, respectively. While during September–October and January–February, the population of *R. dominica* was highest with 25.2, 20.6 and 14.8 and 18.2, 15.80 and 9.0 insects/ 100 g in three districts, respectively. The germination of wheat grain was highest while the infestation was lowest in the wheat samples collected during June–July while it was lowest in case of sample collected during September–October when the infestation was highest. The insect pests caused highest weight loss during September–October and lowest during June–July with a mean of 2.27 and 0.68 per cent, respectively. The mean grain infestation was highest during September–October (21.17%) and lowest in June–July (6.36%).

Key words: Quantitative and Qualitative losses, weight loss, germination, grain infestation

Among cereals, wheat is second important food crop after rice. It is produced by the smallest farmers and stored for domestic use and also for selling later at attractive price. Wheat is attacked by different species of stored grain insect pests, of which *Sitophilus oryzae* Linn., *Rhizorpertha dominica* (Fab.), *Trogoderma granarium* Events and *Tribolium castaneum* (Herbst) were found infesting stored wheat throughout the country (Yadav *et al.*, 1968).

Agroclimatic conditions have direct effect on the incidence of stored grain insect pests and extent of damage caused by them. A significant difference in extent of damage caused by *S. oryzae, R. dominica* and *T. castaneum* in wheat has reported from different parts of the country (Singh *et al.*, 1986 and Singh *et al.*, 1995). Very little work has so far, been carried out on the evaluation of qualitative and quantitative losses in wheat during storage in different parts of the year. Insect pest management in storage requires complete knowledge of the pest, extent of damage, qualitative losses, effect of seasons and agroclimatic conditions on the population of the insects. Therefore, present investigation was carried out to evaluate the quantitative and qualitative losses in wheat in three major wheat producing districts of Western Rajasthan during different period of the year.

MATERIAL AND METHODS

Five villages were selected in Pali, Jodhpur and Jalore districts of Western Rajasthan. A sample of 2 Kg wheat was collected from five randomly selected farmers in each village. The grains were mixed thoroughly and then 500 g of grains were taken from each sample (respective district) by dividing and sub dividing.

Insect Population: A sub sample of 100 g was taken from the representative sample of 500 g. It was spread on the while polythene sheet (45 × 30 cm). The population of *R. dominica*, *T. granarium, S. oryzae, T. castaneum* and *S. cereallela* was counted separately in each sample collected from each district. Samples were collected during June–July, September–October and January–February.

Grain Infestation: The grain infestation was calculated by the following formula:

$$\text{Per cent inf estation} = \frac{\text{No. of inf ested grains}}{\text{No. of total grains}} \times 100$$

The insect wise grain damage was determined by counting the number of grains damaged by individual pest based on specific symptoms as mentioned below:

1. *Sitophilus oryzae* Linn : Presence of irregular emergence hole on the kernel.
2. *Rhizopertha dominica* (Fab.) : Presence of round hole. While, the Kernels retain usual brightness.
3. *Trogoderma granarium* Everts: Feeding beyond germ point gives kernel a irregular shape.
4. *Sitotroga cerealella* (Oliver): Emergence hole are covered with silken covers protruding above the seed surface.
5. Tribolium castaneum (Herbst) : Feeds restrictively on germ creating depression.

Germination: A sample of one hundred grains from each representative sample was placed in moist germination paper, covered with another sheet of paper, which then rolled and kept in polythene bags to prevent moisture loss. The observation on germination of seeds was recorded separately for each sample after 5 days.

Weight Loss: The weight of damaged and undamaged grains in each representative sample was recorded separately and per cent loss in weight was calculated by using the following formula (Adams and Schulten, 1978):

$$\text{Per cent weight loss} = \frac{(U \times Nd) - (D \times Nu)}{U\,(Nd + Nu)} \times 100$$

Where,

U = Weight of undamaged grains

Nu = No. of undamaged grains

Nd = No. of damaged grains

D = Weight of damaged grains

Mean per cent loss in weight was calculated for each district separately.

RESULTS AND DISCUSSION

Population of Insect Pests: The five species of insect pests *viz*; the Khapra beetle, *Trigoderma granarium* Everts; Rice weevil, *Sitophius oryzae* Linn; the lesser grain borer, *Rhizopertha dominica* (Fab); the grain moth, *Sitotrogra cerealella* (Oliver) and lesser grain borer, *Tribolum castaneum* (Herbst) were recorded in wheat samples collected from the Pali, Jalore and Jodhpur districts of Western Rajasthan.

During June–July, the Khapra beetle *T. granarium* was most prominent the population of *S. oryzae* was lowest in all three districts (Table 1). While the population of *S. cerealella* was not recorded during the month of June–July. The population of *T. granarium* was significantly higher than all other insect pests in at three districts of Western Rajasthan. While during the month of September–October and Jan–Feb the lesser grain borer, *R. dominica* was present in highest number followed by *T. granarium, S. oryzae, T. castaneum* and *S. oryzae*. The mean population of *R. dominica* was 25.2 and 18.2, 20.6 and, 15.80, 14.8 and 9.0 insects per 100 gm wheat in Pali, Jodhpur and Jalore district, respectively. Comparatively higher population of all the insect pests was recorded in Pali followed by Jodhpur and Jalore.

The population of insect pests of stored wheat was comparatively higher during Sep–Oct followed by January–February and lowest during June–July. These findings are is agreement with the Singh *et al.* (1992) and Chaudhary *et al.* (1993). They recorded *T. granarium* and *R. dominica* during June–July, *T. granarium* and *S. oryzae* during Sep–Oct and *S. oryzae* and *R. dominica* during Jan–Feb. as prominent species.

Grain Infestation: During June–July *T. granarium* caused significantly higher infestation to grains with a mean of 4.32, 3.50 and 1.28 per cent in Pali, Jodhpur and Jalore, respectively. The lesser grain borer, *R. dominica* was the next important insect pest after *T. granarium* causing 2.63, 1.60 and 0.80 per cent grain infestation in three districts, respectively (Table 2).

During Sep–Oct, *R. dominica* caused significantly higher infestation to grains in all three districts *viz*., 10.40, 7.20 and 5.60% in Pali, Jodhpur and Jalore, respectively. However, no significant difference was found between the grain infestation of *T. granarium* and *R. dominica*. In Pali, the grain infestation ranged from 2.00 to 10.40 per cent. The significantly lowest infestation was caused by *S. cerealella* (2.0%).

Similarly, in Jodhpur and Jalore grain infestation caused by *R. dominica* (7.20 and 5.60%) was higher but at par to *T. granarium* (5.60 and 4.10%). In Jalore, *R. dominica* also caused highest grain infestation followed by *T. granarium* (4.10), *S. oryzae* (1.20%), *T. castaneum* (1.10%) and *S. cerealella* (0.16%).

During Jan–Feb survey *R. dominica* caused higher infestation in Pali and Jodhpur. With an average of 6.80 and 5.40 per cent, respectively. In Jalore, *T. granarium* caused the highest infestation (3.10%), which was at par to *R. dominica* (2.80%).

The over all mean grain infestation in Western Rajasthan varied from 0.50 to 4.80 per cent and *R. dominica* caused highest infestation (4.80%) followed by *T. granarium* (4.25%). Earlier, Singh and Yadav (1995) reported that *R. dominica* is able to inflict consistent damage through the year.

Table 1. Population of insect–pests in stored wheat during surveys in three districts of Western Rajasthan

Insect pests	Population/ 100 g wheat											
	1st (June–July)				2nd (Sep–Oct)				3rd (Jan–Feb)			
	Pali	Jodhpur	Jalore	Mean	Pali	Jodhpur	Jalore	Mean	Pali	Jodhpur	Jalore	Mean
S. oryzae	1.2	0.8	0.6	0.87	4.6	3.2	2.8	3.53	3.6	3.0	2.2	2.93
R. dominica	3.6	3.0	2.2	2.93	25.2	20.6	14.8	20.20	18.2	15.8	9.0	14.33
T. granarium	8.6	6.8	3.2	6.20	18.6	12.8	13.2	14.80	14.8	10.2	10.6	11.80
S. cerealella	0.0	0.0	0.0	0.00	1.6	1.0	0.6	1.06	0.8	0.6	0.2	0.53
T. castaneum	2.8	2.4	2.0	2.40	3.2	2.8	2.6	2.86	2.6	2.2	1.8	2.20
SEm±	0.1902	0.1649	0.1460		27370	1.2898	0.5755		0.7662	0.9449	0.7013	
CD (5%)	0.5611	0.4865	0.4307		21742	3.8049	1.6977		2.2603	2.7963	2.0689	

Table 2. Grain infestation by storage insect–pests during different surveys in three districts of Western Rajasthan

Insect pests	Grain infestation (%)												Overall mean
	1st (June–July)				2nd (Sept.–Oct.)				3rd (Jan. – Feb.)				
	Pali	Jodhpur	Jalore	Average	Pali	Jodhpur	Jalore	Average	Pali	Jodhpur	Jalore	Average	
S. oryzae	1.14 (6.02)	0.48 (3.97)	1.18 (6.02)	0.93	4.50 (12.25)	3.10 (10.14)	1.20 (6.29)	2.93	2.50 (9.10)	1.80 (7.71)	1.20 (6.29)	1.83	1.89
R. dominica	2.63 (9.28)	1.60 (7.27)	0.80 (5.13)	1.67	10.40 (18.81)	7.20 (15.56)	5.60 (13.69)	7.73	6.80 (15.12)	5.40 (13.44)	2.80 (9.63)	5.00	4.80
T. granarium	4.32 (11.97)	3.50 (10.78)	1.28 (6.29)	3.03	8.30 (16.74)	5.60 (13.69)	4.10 (11.68)	6.00	5.00 (12.97)	3.08 (9.98)	3.10 (10.14)	3.73	4.25
S. cerealella	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	2.00 (8.13)	0.56 (4.29)	0.16 (2.29)	0.91	0.60 (4.44)	0.49 (4.01)	0.68 (4.73)	0.59	0.50
T. castaneum	0.75 (4.97)	0.50 (4.05)	(0.90) (5.44)	0.72	7.20 (15.56)	2.50 (9.10)	1.10 (6.02)	3.60	2.00 (8.13)	1.60 (7.27)	0.90 (5.44)	1.50	1.94
Total				**6.35**				**21.17**				**12.61**	
SEm ±	0.468	0.68	0.816		1.30	1.19	1.02	21.17	1.00	0.86	0.77		
CD at 5%	1.35	1.96	2.36		3.77	3.45	2.95		2.90	2.49	2.23		

Values in parentheses are angular transformed values of percentage.

Table 3. Grain infestation, moisture contents, germination and weight loss of stored wheat during different surveys in three districts of Western Rajasthan

Name of District	Surveys	Infestation (%)	Moisture content (%)	Germination (%)	Weight loss (%)
Pali	1st (June–July)	8.84 (17.26)	8.66 (17.05)	92.40 (76.44)	0.95 (5.56)
	2nd (Sept.–Oct.)	32.4 (34.70)	11.08 (19.37)	70.40 (57.04)	3.47 (10.63)
	3rd (Jan.–Feb.)	16.6 (24.04)	10.78 (19.09)	88.40 (70.18)	1.83 (7.71)
Jodhpur	1st (June–July)	6.08 (14.18)	9.10 (17.56)	91.60 (73.26)	0.65 (4.62)
	2nd (Sept.–Oct.)	18.96 (25.77)	10.60 (19.00)	66.80 (54.82)	2.03 (8.13)
	3rd (Jan.–Feb.)	12.48 (20.68)	10.30 (18.72)	89.20 (70.81)	1.34 (6.55)
Jalore	1st (June–July)	4.16 (11.68)	9.00 (17.46)	88.80 (70.45)	0.45 (3.80)
	2nd (Sept.–Oct.)	12.16 (20.36)	10.80 (19.19)	71.80 (57.92)	1.30 (6.55)
	3rd (Jan.–Feb.)	8.68 (17.05)	10.30 (18.72)	89.40 (71.09)	0.93 (5.44)
	SEm ±	2.5644	0.3178	3.34	0.77
	CD at 5%	7.3829	0.9149	9.62	2.21

The mean infestation to grains was highest during Sep–Oct followed by Jan–Feb and lowest in June–July. During the June–July Sep–Oct and Jan–Feb the mean grain infestation was highest in Pali followed by Jodhpur and Jalore (4.16%). The mean values were 8.84, 32.40 and 16.48; 6.08; 18.96 and 12.48; 4.16, 12.16 and 16.48 per cent respectively.

The average grain infestation was 6.35% during June–July which increased considerably to 21.17% during Sep–Oct, and declined to 12.61% during Jan–Feb. The present findings tally with the findings of Singh and Yadav (1995) who reported 6.23 to 14.15 per cent infestation in wheat.

The grain infestation was highest in Pali followed by Jodhpur and lowest in Jalore. The higher grain infestation in Pali may be attributed to prevailing higher humid conditions than Jodhpur and Jalore. The grain infestation highest during Sep–Oct when atmospheric humidity was higher due to rainy season and after that it decline in Jan–Feb. Earlier similar results was also reported by Shankar Das (1977).

Germination Per cent: The mean germination of wheat samples collected during June–July from Pali, Jodhpur and Jalore was 92.4, 91.6 and 88.8 per cent respectively. Similarly, during Sep–Oct and Jan–Feb the respective value was 70.4 and 88.4, 66.8 and 89.2 and 71.8 and 89.4 per cent.

In Pali, Jodhpur and Jalore the mean germination per cent of the wheat samples collected during Jun–July survey was significantly higher than the Sep–Oct survey, however it was at par to the mean germination per cent of the wheat samples in Jan–Feb.

Thus, the results clearly indicated that wheat shored in June–July exhibited significantly higher germination per cent than during Sep–Oct in all three districts of Western Rajasthan. Singh and Yadav (1995) reported that average germination in the Punjab was at 93 per cent while actual germination in the seed without separation of damaged kernel was 83 per cent.

Weight Loss: The mean weight loss in wheat was highest in Pali followed by Jodhpur and lowest in Jalore during June–July, Sep–Oct. and Jan–Feb (Table 3). The mean weight loss in wheat grain in Pali during Sept–Oct, June–July and Jan–Feb was 3.47, 0.95 and 1.83 per cent, respectively. In Jodhpur and Jalore during Sep–Oct, June–July and Jan–Feb the weight loss in wheat 2.03, 0.65 and 1.34 and 1.30, 0.4 and 0.93.

In Pali weight loss during Sep–Oct was significantly higher than Jan–Feb and June–July. However, no significant difference in weight loss during June–July and Jan–Feb was after. In Jalore, the weight loss in wheat grain during Sep–Oct and Jan–Feb was at par but significantly higher than weight loss in June–July.

The mean weight loss in wheat grain during different surveys ranged from 0.95 to 3.47, 0.65 to 2.03 and 0.45 to 1.30 per cent in June–July and Sep–Oct in Pali, Jodhpur and Jalore, respectively.

The present finding gets full support from the findings of Shankar Das (1977) who reported negligible weight loss during June–July, 5.1 and 3.0 per cent during Sep–Oct and December–January, respectively.

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