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Grain Losses Caused by House Rat *Rattus rattus* L. and Its Control

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Abstract.- The house rat, *Rattus rattus* L. caused significant losses to wheat grains. The food preference estimates revealed that the wheat grains were more preferred for consumption as compared to maize and barley grains, respectively. Racumin (coumatetralyl) anticoagulant chronic poison at 0.0375% concentration provided 100% mortality of rats in different godowns. The activity index of rat was 67-82% before baiting. The use of Racumin bait gave best control showed zero per cent activity index after continuous baiting for 10 days. It could therefore, be inferred that Racumin at 0.0375% concentration effectively be applied to control house rat.

Key words: Grain losses, house rat control, racumin.

INTRODUCTION

The house rat *Rattus rattus* L. (Rodentia: Muridae), is one of the most commonly encountered and economically important of the commensal rodents. This rat not only inflicts heavy damage to stored food but also have nuisance value being a disease carrier or vector. It is purely an indoor pest in Pakistan (Roberts, 1977; Brooks *et at.,* 1987). Due to its wide distribution, high abundance, great dependence on man's food it is probably one of the most important pest in Pakistan (Ahmed *et at.1995;* Khokhar et *at.,* 1999; Hussain and Iqbal, 2002).

The control of rodent pests should be approached as a management practice much more than a simple and single poisoning action. Anticoagulant rodenticides interfere with the blood clotting mechanism of the body, the animal gradually dies because of loss of blood through internal haemorrhages. The death is painless and due to the delayed action the bait shyness with anticoagulants is unusual even with higher concentrations of active ingredient (Richards, 1988). The present work was conducted to study the infestation of house rat in grain godowns and its control.

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MATERIALS AND METHODS

The study was carried out on wheat, barley and maize grains at Loralai, district of Balochistan in five godown. The size of each godown was 120' x 150' and the height of the godowns was 25 ft. The distance between each godown was 50 ft.

Grain losses

To estimate the damage of house rat and its losses in wheat grains were carried out in 5 godowns at Loralai, Balochistan For this purpose 5 different places were established as feeding station. On each station 1000 grams of healthy wheat grains were placed in a cloth bag. The unconsumed grains were collected regularly from each station and weighed after every 24 hours. This procedure was repeated for 10 consecutive nights and the grain losses/day/godown was recorded.

Food preference

In order to estimate the food preferred by rats, different cereal grains *i.e.* wheat, maize and barley were tested. For this purpose 500 grams of each food was placed in different 5 godowns for 7 consecutive days. Each food was individually weighed on every morning and consumed amount was recorded. At the end of the 7th days each food was ranked regarding the preference and consumed food in large amount was selected for bait material. No population of house rats was determined

however, the activity index percent of foot prints of rats was recorded.

Activity index

In order to estimate the population of the rat in godowns, the change in ratio (CIR) of tracking activity method was used. In this method foot print of rats were observed and activity index was computed. The activity before and after baiting was measured with half inked tracking tiles. The tracking tiles were made-up of tin sheets of size (12" x 10"). The tiles were painted with black ink with the help of brush. They were placed in godowns at every night in all areas, where rats were expected to be moving at night hours. Fifteen tiles were placed in each godown. The tiles having foot prints on the unpainted half portion were observed as positive tiles. The data was recorded after every 24 hours at morning. The prints on tiles were cleaned up from uninked portion. After recording the data the tiles were placed again applying the same procedure. The activity was recorded for 5 nights. This gave in index of relative rat activity/population and was calculated as under (Prakash *et al*., 1971; Barnett and Prakash, 1975; Quy *et al*., 1993).

$$\text{Activity Index} = \frac{\text{No. of positive tiles}}{\text{Total No. of tiles placed}} \times 100$$

Bait consumption

The concentration of bait Racumin (coulmatetralyl) was used as 0.0375% as an anticoagulant chronic poison. The following ingredients were mixed at the proportion of Racumin 375 gm, broken wheat 375 gm, edible oil 375 gm and brown sugar 375 gm. All the 5 godowns were baited with poison. In each godown 5 baiting sites (stations) were established, in such a way they covered all the area of each godown. Baits were placed on the floor in order to provide the natural feeding site. On each station 300 gm of baits were offered in the evening before sunset, checked and replenished after every 24 hours. This procedure was repeated for 11 days till the rats died.

RESULTS AND DISCUSSION

Grain losses

The results on the daily grain losses of wheat grains by house rat at different godowns are presented in Table I. A critical review of the data revealed that the consumption of wheat grains by the rats started from the very 1st day of the experimentation at all the godowns, however, the consumption was significantly the lowest (449.8 g) when compared with the rest of the days. Since F-value for days was calculated to be 12.068 and its corresponding p-value was 0.000 whereas, means were separated using Duncan Multiple Range Test (DMRT). The consumption of the wheat grains by the rat increased gradually as the rats became used to the new sites. The maximum grain losses (consumption) was recorded on 9th day (552.2 g) of the. experimentation followed by the day (530.4 g) and the variation between the daily grain losses of these days were statistically non-significant ($P \geq 0.05$) as the Duncan multiple range test assigned the same letters to above means. The analysts of variance showed significant variations in daily grain losses by rat amongst the days of the data, whereas, the application of DMR test for separation of the mean values indicated that the differences in grain losses made 6 groups in which means were not significantly different from one another.

It is also evident from the data on daily grain losses at different godowns that consumption of grains varied significantly with the godowns (Table I for F-value and Degrees of Freedom). The grain consumption was significantly highest (541.6 grams) at godown E followed by D (526.8 g), C (503.7 g), B (478.4 g) and A (471.0 g), as shown in Table I. The analysis of variance revealed significant variations amongst the godowns, however, application of DMRT to mean daily consumptions indicated that the variations between godown D and E were statistically non-significant ($P \geq 0.05$). Similarly the difference between godown A and B were also statistically non-significant regarding daily grain consumption by rats. This may be attributable to the variations in the population size at different godowns (Table VI).

Food preference/consumption

The data on the estimation of different foods consumed by house rats to determine the food preference are presented in Table II. The results revealed that average amount of food consumed per

Table I.- Daily wheat grain losses (in grams) by house rat.

Day	Godown					Mean grain loss/day	
	A	B	C	D	E	Mean	SE
1st	405	417	436	483	508	449.8 f	19.70
2nd	421	440	466	497	523	469.4 e	18.51
3rd	455	471	495	530	550	500.2 cd	17.74
4th	430	465	505	497	535	486.4 de	17.97
5th	485	510	525	530	557	521.4 bc	11.85
6th	505	485	490	525	544	509.8 bcd	11.02
7th	495	532	553	545	527	530.4 ab	9.88
8th	514	486	506	525	543	514.8 bc	9.50
9th	528	537	558	577	561	552.2 a	8.78
10th	472	441	503	559	568	508.6 bcd	24.50
Mean	471.0 c	478.4 c	503.7 b	526.8 a	541.6 a	504.3	6.05
SE	13.26	12.60	11.60	9.0	5.89		

Mean followed by similar letters are statistically non-significant (P≥0.05) as estimated by Duncan Multiple Range Test.

Analysis of variance

Source	Type III Sum of Squares	df	MS	F-value	Sig.
Days	39762.500	9	4418.056	12.068	.000
Godown	36776.000	4	9194.000	25.113	.000
Error	13180.000	36	366.111		
Corrected total	89718.500	49			

Table II.- Amount of different foods consumed per week (in gram) by house.

Day	Amount of food consumed/week in godown						
	A	B	C	D	E	Mean	SE
Wheat	1456	1480	1525	1561	1521	1508.6 a	18.38
Maize	670	743	806	783	815	763.4 b	26.46
Barley	131	303	319	351	300	317.6 c	9.11
Mean	813.0	842.0	883.3	898.3	878.7	863.0	131.76
SE	337.61	343.36	350.28	354.03	353.91	131.76	

Mean followed by similar letters are statistically non-significant (P≥0.05) as estimated by Duncan Multiple Range Test.

Analysis of variance

Source	Type III Sum of Squares	df	Mean square	F-value	Sig.
Food	3623085.733	2	1811542.867	1841.404	.000
Godown	14544.933	4	3636.233	3.696	.055
Error	7870.267	8	983		
Corrected total	3645500.933	14			

godown varied significantly (P≤0.05) with the food offered. It is clear from the data that average consumption of wheat grains was statistically highest (1508.6 g) when compared with maize (763.4 g) and barley (317.6 g). This indicated that wheat grains were the most preferred food followed by maize and barley. It is also evident from the results that the pattern of food preference at different godowns was almost identical. Further, the ANOV A of the variations in food consumptions at different godowns were statistically non-significant (P≥0.05).

Table III.- Activity index percent (days) of foot print of house rat.

Day	Activity index % (Days)						
	A	B	C	D	E	Mean	SE
A	80.0	66.6	60.0	73.3	60.0	67.98 b	3.89
B	66.6	53.3	53.3	80.0	86.6	67.96 b	6.80
C	80.0	80.0	73.3	86.6	86.6	81.30 a	2.49
D	80.0	66.6	73.3	80.0	80.0	75.98 ab	2.68
E	100.0	73.3	86.6	80.0	73.3	82.64 a	4.99
Mean	81.32	67.96	69.30	79.98	77.30	75.17	2.23
SE	5.34	4.43	5.80	2.10	4.97	2.23	

Mean followed by similar letters are statistically non-significant (P≥0.05) as estimated by Duncan Multiple Range Test.

Analysis of variance

Source	Type III Sum of Squares	df	Mean Square	F-value	Sig.
Godown	988.570	4	247.143	3.209	.041
Activity	759.682	4	189.921	2.466	.087
Error	1232.158	16	77.010		
Corrected total	2980.410	24			

Table IV.- Trend of bait consumption (in grams) by house rat in various godowns.

Day	Godown					Mean grain loss/day	
	A	B	C	D	E	Mean	SE
1st	269	270	237	259	270	261.0	6.35
2nd	307	297	289	287	298	295.6	3.57
3rd	321	311	298	311	320	312.2	4.14
4th	180	160	140	160	180	164.0	7.48
5th	176	129	111	101	119	127.2	13.04
6th	146	121	98	79	93	107.4	11.78
7th	109	100	88	39	50	77.2	11.87
8th	67	65	40	20	27	43.8	9.62
9th	46	11	13	5	17	18.4	7.17
10th	13	4	5	0	6	5.6	2.11
11th	6	9	0	0	0	1.2	1.90
Mean	149.09 a	133.45 b	119.91 c	114.64 c	125.45 bc	128.67	15.18
SE	34.18	34.49	33.22	36.38	36.90	15.18	

Duncan multiple range test has been applied to separate means. Mean grain losses values followed by similar letters are statistically non-significant (P≥0.05).

Analysis of variance

Source	Type III Sum of Squares	df	Mean Square	F-value	Sig.
Godown	8056.836	4	2014.209	10.698	.000
Day	668568.109	10	66856.811	355.094	.000
Error	7531.164	40	188.279		
Corrected total	684156.109	54			

Activity index

The activity index or population estimation of house rat at different godowns through percent of foot prints (Table III) indicated that pre-treatment activity (population size) varied significantly with the godowns. However, the variation in population

size as recorded through foot prints for 5 days was not statistically significant on different days. The population size of house rat was significantly larger (82.64%) in godown E and it was followed by godown C (81.3%), D (75.98%), A (67.98%) and B (67.96%), respectively. The analysis of variance revealed significant variations in population size at different godowns; however, variations in activity index on different days were statistically non-significant ($P \geq 0.05$). The variation between godown C and E regarding activity index were statistically non-significant. Similarly, the differences in activity index at godowns A, B and D were also statistically non-significant ($P \geq 0.05$).

Bait consumption

The results on the trend of bait consumption by house rat at different godowns are presented in Table IV. The bait consumption was significantly higher (149.09 g) at godown A and followed by B (133.45g), E (125.45 g), C (119.91 g) and D (114.64 g). The analysis of variance revealed significant variations amongst the godowns; however, DMR test indicated that variations amongst godown, C, D and E were statistically non- significant in an over-lapping manner.

The data on trend of bait consumption during different days revealed that daily bait consumed was 261 g during 1st day of experimentation. The bait consumption increased gradually and reached to its peak (312.2 g) during 3rd day of experimentation. Thereafter, the bait consumption by house rat at all the godowns decreased drastically and reached to significantly the lowest (1.2 g) on 11th day indicating the mortality of all the rats present in the godowns. The analysis of variance revealed significant variations in bait consumed daily, however, the CD values to the mean bait consumed per day showed that the difference between 2nd day and 3rd day was statistically non-significant ($P \geq 0.05$), whereas, the difference amongst the rest of the days of the experiment were statistically significant.

The house rat is largely commensal of man which infects all sorts of human habitations ranging from adobe hutments, villages, towns or cities located in the plains as well as on the mountains upto 1980 meters elevation. Although it is omnivorous in feeding habits, the rats heavily depends for its nutrients upon food grains collected and stored by man as well as his refuse and discarded garbage. According to Parkash (1989) *Rattus rattus* depends on agricultural products for its food and this species undoubtedly does enormous damage to wheat godowns where it has attained a serious pestiferous status. In the present investigations house rat consumed much wheat grains as compared to other foods grains and caused gigantic losses. Also, many research workers reported rodent's damage to food grains in ware houses (Sridhara and Krishnamoorthy, 1979; Yabe, 1979; Hemendez and Drummond, 1984). Habitat or in other words availability of food seems to have significant influence on the food habits of the house rat. The rat food preference for wheat is evident from the data of the present studies these results are in close conformity to those reported by Hassan *et al.* (1995) who reported that house rat largely depends on wheat for its food. The house rat of the rural central Punjab depended on wheat which accounted for 58.8% of the total dry weight of the diet. Flour mills 70.2% and village house 67.4% rats consumed wheat more intensively than the farm house 53.5% and shop 45.3% rats. Rice 6.3%, fodders 6.3%, pulses 5.8% were the other important staples of the rats diet. The preferred food items can help in developing effective and efficient food baits for rat control. Wheat can be a suitable carrier for the preparation of poison baits (Chopra *et al.,* 1984). Many research workers selected the most preferred food items for preparation of poison bait for the control of rats (Otsu, 1979; Posamenter and A1am, 1981; Sridhara and Srihari, 1983; Soni and Rana, 1982).

The investigations on the control of rat through Rucumin bait revealed 100% mortality after 10 days of baiting in different godowns. These results are in absolute conformity with the results of Chopra and Prashad (1985) who also achieved 100% mortality of house rat after 10 days of continuous baiting (0.0375% coumatetralyl). Whereas, Arora *et al.* (1984) also observed 100% mortality in both sexes of house rat with 0.0375%, Racumin a coumatetralyl based anticoagulant. It could therefore, be inferred that Racumin at 0.0375% concentration gave 100% mortality of the house rats in all godowns.

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