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ASSESSMENT OF RAT DAMAGE SURROUNDING THE WATCH TOWER AREAS AND NEST BOX OCCUPATION BY OWL

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Abstract

A study was carried out to assess the rat damage around the watching tower and the effectiveness of nest box for owl occupation at Rajshahi and Gazipur district. Watching towers were set at the field and nest box were installed in different trees above 3.7 – 4.5 m from the ground level in both the locations. Wheat, barley, potato, sweet potato and groundnut crop damaged by rat were assessed at 0-25, 26-50 and 51-75 m apart around the watching tower areas. Nest box occupancy was also recorded for nesting and roosting by owl. Percent rat damage in different growth stages of wheat and barley differed significantly in active burrow count methods and cut uncut methods around the owl watching tower areas. Significantly the lowest number of active burrows (0.6) was recorded in 0-25-m distance around the watching tower followed by 25-50-m distance and the highest number of active burrows was observed in 50-75 m distance from watching tower both in Rajshahi and Gazipur. Rat damaged and number of active burrows were higher as the distance increased from the watching tower areas. In Rajshahi, 55 % nest boxes were occupied by owl whereas 50 % nest boxes were occupied by owl in Gazipur. In Gazipur maximum nest boxes were occupied by spotted owlet (*Athene brama*) and in Rajshahi most of the nest boxes occupied by barn owl (*Tyto alba*).

Keywords: *Tyto alba*, *Athene brama*, watch tower, rat damage, wheat, potato.

Introduction

Rodents considerably damage agricultural production around the globe. Singleton (2003) estimated losses of 5-10% in annual rice production in Asia. Rats are the serious pest of wheat crop throughout southern Asia causing damage from 3.5 to 12% (Ahmad, 1986). In Bangladesh yield loss caused by rats ranging from 32% to 67%, damage elongation was more severe during ripening stage (Aplin *et al*., 2004) and in another study pre-harvest losses ranging from 5- 17% (Belmain and Shafali, 2008). Higher rodent damage was observed in wheat crop (13.25%) while 6.90% damage was observed in rice. Burrowing rats hoard a considerable amount of rice and wheat grain in their burrow. Rodents reproduce at an alarming rate. One female mouse or rat can produce up to 120 offsprings in a single year. The over-population of rodents can equal devastation to anyone working in the agricultural business. Trapping and the use of poisons are typical remedies for a rodent infestation. But the rodents catch on to the use of traps and poisons are damaging to our eco-systems. Moreover, poison treatments are frequently tardy both because

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rodent population outbreaks are unpredictable and poisons have short-run impacts due to the rapid immigration of rodents from adjacent untreated areas; furthermore, poisons are often considered by farmers to be too costly (Skonhoft *et al*., 2006, Davis *et al*., 2004, Stenseth *et al*., 2003). Risks of mortality by self-poisoning (Eddleston, 2000) and detrimental impacts on non-target animals are additional drawbacks of rodenticides. Crop quality, eco-systems and local wildlife are all adversely affected by the use poisons. Using poisons to management rodent control causes a ripple effect within the eco-system. The poisons can leech into the soil and subsequently get washed in to the watershed through rain water and crop irrigation. For additional wildlife, rodent poisoning can equal death. If a predator ingests a poisoned rodent, they can become extremely ill and die. The cycle continues if that predator is eaten by another animal and so on. Installing barn owl boxes is an effective addition to integrated pest management. They cause no damage to the environment or agricultural crops and pose no threat to additional wildlife.

Barn owls are superior hunters, preying on small nocturnal mammals including mice, rats, voles, and gophers. Install a nest box to encourage barn owls to your property for natural rodent control. Barn owls need open fields or grassy slopes in which to hunt for prey. A single pair of barn owls can consume over 2000 rodents a year. Installing barn owl nesting boxes and watching tower throughout the crop field is a sure way to diminish the number of rodents destructing your crops. And because barn owls are not as territorial as other raptors, numerous boxes and watching tower can be installed throughout crop field to effectively control growing rodent population. Installing owl nest boxes and watching tower to control rodent population is an extremely cost-effective remedy. The cost to purchase and/or install an owl nest box is a one-time investment. Owl boxes from air superiority require little to no maintenance. The population of different owl species are decreasing day by day due loss or destruction of vegetation and large tree which is suitable for owl nesting and increased breeding success. The occupation of nest boxes varied with exposure and orientation. A higher percentage of occupation and more barn owl nestlings per breeding attempt were found in nest boxes located in the shade than in the sun, and in those facing east/north rather than other directions. The temperature in the nest boxes varied, being lowest in those located in the shade and in those facing east. Nest boxes located in crop fields fledged younger per breeding attempt than those located in date plantations (Charter *et al*., 2010) Increasing owl population and conservation installation of nest box is very important. In our crop field there are very little scope for searching and capturing rodent prey from crop field for owl. Therefore, watching tower installation is also important for seating, searching and capturing prey. Very little or no study has been done in these regards. The aim of the study was to assessethe rat damage around the watching tower and the effectiveness of nest box for owl occupation.

Materials and Methods

Fig.1. Owl watch tower

Fig. 2. Owl nest box

The study was conducted at Bangladesh Agricultural Research Institute, Gazipur experimental field and residential areas, and Regional Wheat Research Centre, Shampur (24.37 N, 88.66E), Rajshahi and Fruit Research Centre, Binodpur, Rajshahi ($24^0$36' N, $88^0$65'E). Twenty owl watching towers and fifteen nest boxes were installed in both the location. Watching tower are 3.7 – 4.5 m long pole prepared by bamboo with cross (X) shaped top for seating owl on it and perching and searching rat in crop field (Fig 1). Nest box (87 cm × 89.5 cm × 90.5 cm) is a triangular shaped box staying and breeding for owl safely (Fig 2). Nest boxes were installed in different tree and building above 15 feet apart from the ground level. One nest box was set for every four hectare of crop field. When Nest box was used by owl species for nesting, roosting and breeding was term as owl occupation. Nest box was set in north and east side to avoid excess sunlight and wind.

Wheat, barley, potato, sweet potato and groundnut crops damaged by rat were assessed around the watch tower areas. Rat damage assessment around the owl watching tower was done by two ways. One Number of active burrows count methods and another crop damage assessment method. Active burrow count and crop damage was done three different distance 0-25, 26-50 and 51-75 m apart around the owl watching tower according to some modification of Malhotra and Singla (2018). Data were recorded in three crop stage i.e., booting, grain filling and mature stages of the crop.

Rat damage estimation by cut and uncut method

Wheat and barley damage was estimated by this method. The experiment was laid out following randomized complete block design with 10 replications. Ten plots were randomly selected. In each plot ten samples were taken. The data from these ten samples were used for calculation the damage in each plot as a percentage. Very large or very small plots were not selected for sampling data. Ten samples along one of the diagonals were selected in each plot. The distance between samples (between 3 to 5 steps) depends on the length of the diagonal. A sample closer than 3 m (3 large steps) from any edge of the plot was not chosen. Each sample consists of 50 cm square frame in which all tillers, cut and uncut tillers were counted. These figures were put on a record sheet. The sampling frame in placed without looking, so that taking data would be real. After taking data from one plot next plots were selected randomly and repeated up to ten samples.

Percent wheat and barley damage was calculated with following formula:

$$\text{Percent rat damage } = \frac{\text{Number of cut tillers}}{\text{Total number of tillers}} \times 100$$

Data were taken every 15 days interval up to harvesting of the crop.

Rodent damage of groundnut in the form of per cent pods damaged was recorded at 0-25 m, 26-50 m and 50-75 m distance from the watch tower areas. At each watch tower distance area 2 m x 2 m quadrats were placed. Five plants were uprooted from each quadrat randomly to count the total number of pods and the pods damaged by rodents (those with signs of rodent gnawing) per plant. Average number of pods damaged per plant and average density of plants/4m^2 were determined for each field. Percent pods damaged were calculated using the formula given below:

$$\text{Percent pod damaged} = \frac{\text{Damaged pods}}{\text{Total pods}} \times 100$$

Potato and sweet potato damage by rat in the form of percent tuber damaged was also recorded at

0-25 m, 26-50 m and 50-75 m distance from the watch tower areas. Sampling of potato and sweet potato damaged was recorded as same as the groundnut. Percent tuber damaged of potato or sweet potato were calculated using the following formula

$$\text{Percent tuber damaged} = \frac{\text{Damaged tubers}}{\text{Total tubers}} \times 100$$

Collected data were analyzed by one-way analysis of variance by IBM SPSS 26 statistical software and means were separated by Tukey's HSD test. All results are presented as mean ± SE. Graphical data were presented by Sigma plot software.

Results and Discussion

Rat damage Assessment

Percent rat damage in different growth stage of wheat differed significantly in active burrow count methods and cut uncut methods around the owl watching tower areas (Fig. 3 and 4). Significantly the lowest number of active burrow (0.6) was recorded in 0-25-m distance around the watching tower followed by 25-50 m (1.5) distance and the highest number of active burrows was observed in 50-75 m (7.5) distance from watching tower in Rajshahi. In case of cut and uncut methods follow the same trend as active burrow count methods. (Table 1). Wheat and barley damaged by rat in the form of active burrows and grain damaged at Gazipur also followed the same trend as Rajshahi. Rat damaged and number of active burrows were higher as increase the distance from the watch tower areas (Fig. 5-8)

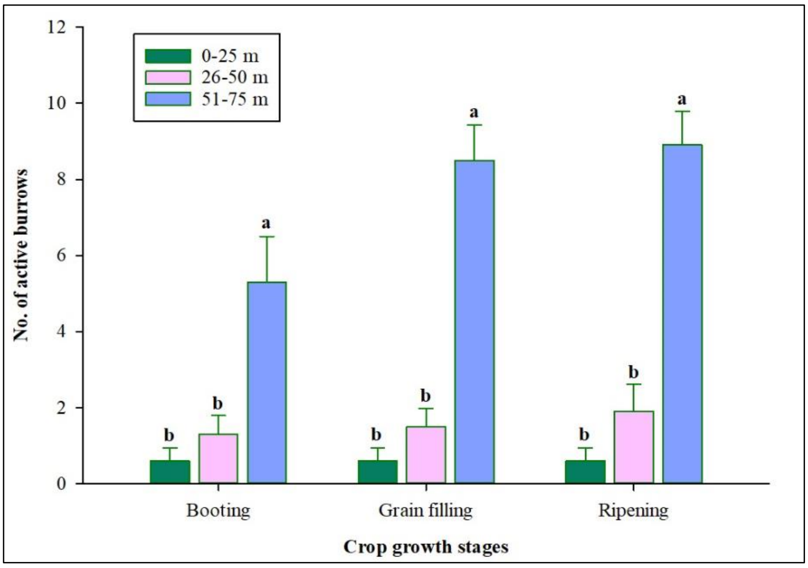

Fig. 3. Extent of rat damage in different growth stage of wheat around the watching tower area at Rajshahi by active burrow count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

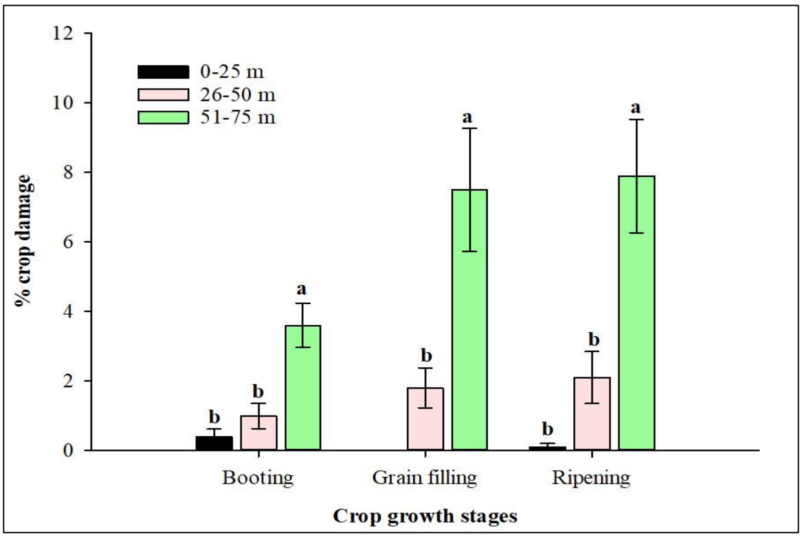

Fig. 4. Extent of crop damage in different growth stage of wheat around the watching tower area at Rajshahi by cut and uncut count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

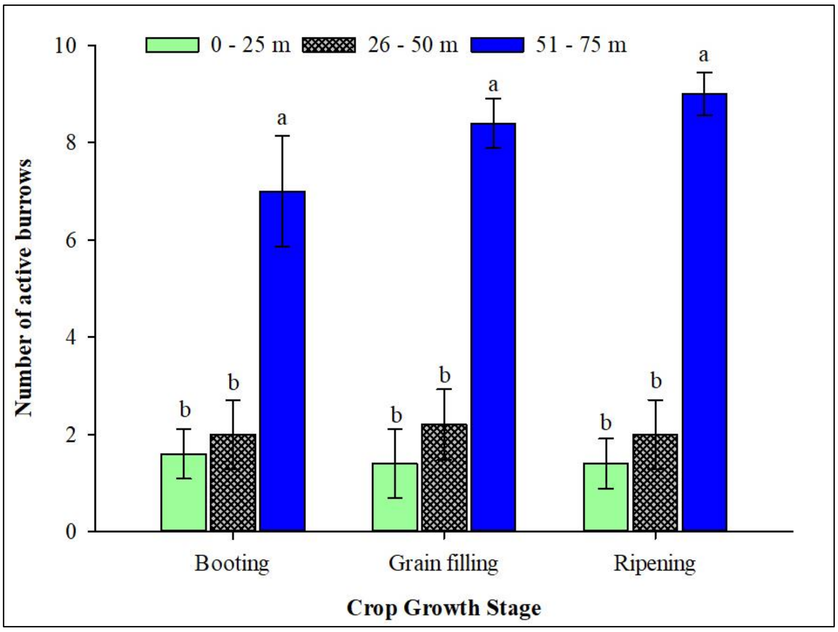

Fig. 5. Extent of rat damage in different growth stage of wheat around the watching tower area at Gazipur by active burrow count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

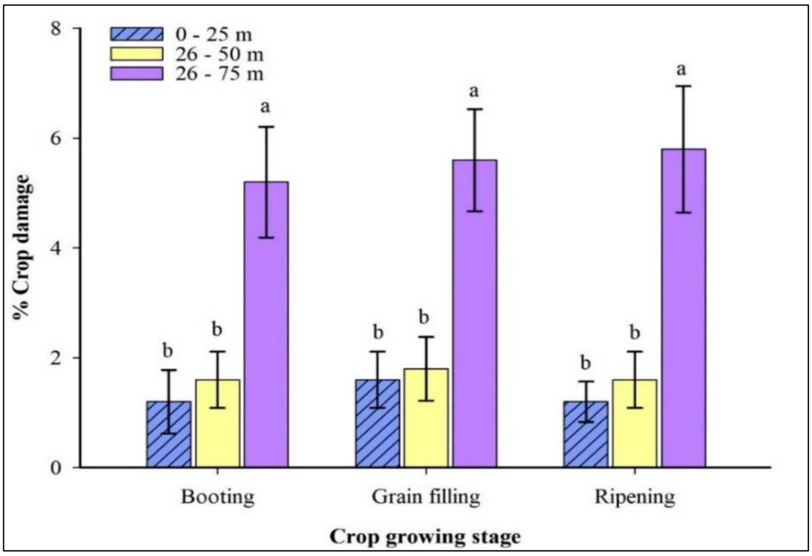

Fig. 6. Extent of crop damage in different growth stage of wheat around the watching tower area at Gazipur by cut and uncut count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

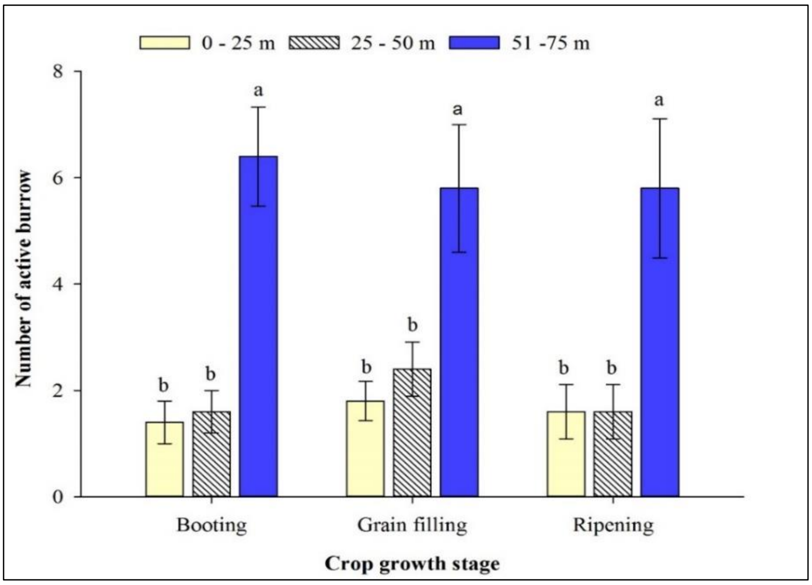

Fig. 7. Extent of rat damage in different growth stage of Barley around the watching tower area at Gazipur by active burrow count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

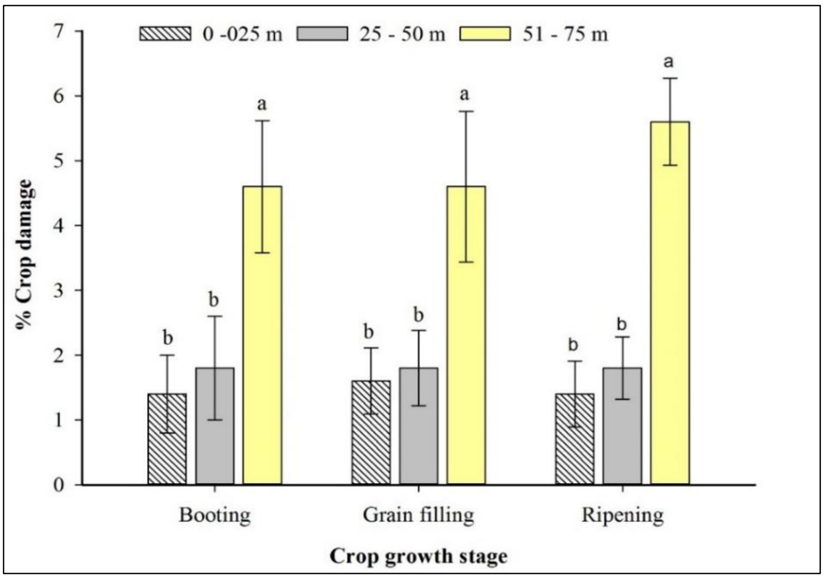

Fig. 8. Extent of crop damage in different growth stage of Barley around the watching tower area at Gazipur by cut and uncut count method. Error bars indicate ± SE, Means followed by the same letter (s) are not significantly different at 5% level by Tukey's HSD.

Potato, sweet potato and groundnut damaged by rat and number of active burrows were differed significantly among different distance (0-25 m and 25-50 m and 51-75 m) from the watch tower. The number of active burrows ranged from 1-1.8, 1.2-1.6 and percent damaged ranged from 0.6-1.0, 0.6-1.8 at 0-25 m and 25-50 m distance from the watch tower in potato and sweet potato respectively compared to 51-75 m distance from the watch tower at Gazipur (Table 1). Number of active burrows and nut damaged in ground nut was also followed the same trend as potato and sweet potato at different distance from the watch tower (Table 1). Because owl can be easily search and detected the prey within 50 m that's why the rat damaged and active rat burrows were lower within the 50 m. Malhotra and Singla (2018) studied the live active burrows count at four different radii such as 0-100 m, 101-500 m, 501-1000 m and 1001-2000 m distance around roosting and nesting sites at Punjab, India and found that numerically lower active burrow within 100 m radius and being highest at 1001-2000 m radius but no significant among four distances. In another study (Johnson and George, 2020) a rigorous estimate of the number of rodents that barn owls remove from the landscape to nest box by using remote nest box cameras at wine grape orchard in California, USA. Results indicate that each barn owl chick received 170.2 ± 8.92 rodents before dispersing from the nest box. Combined with the average number of chicks fledged (3.62 ± 1.40), this finding indicates adults deliver on average 616 rodents per nest box, they also estimated a barn owl family could remove 3,466 rodents in a full year (estimates ranged from 1,821 to 7,563). An analysis linking videography to owl telemetry data suggested that 43% of rodents killed were taken from vineyard habitat, which nearly matches the availability of vineyard habitat around the monitored nest boxes (46%). Their results suggest barn owl nest boxes could contribute meaningfully to integrated pest management.

Table 1. Extent of rat damage of potato, sweet potato and groundnut around the watching tower area at Gazipur in Bangladesh

Crop	Watch tower distance (m)	Extend of rat damage	
		Number of active burrow (Mean ± SE)	% Tuber/pod damage (Mean ± SE)
Potato	0 -25	1.0 ± 0.32 a	0.60 ± 0.24 a
	26 -50	0.80 ± 0.37 a	1.00 ± 0.45 a
	51 -75	3.4 ± 0.68 b	3.0 ± 0.45 b
Sweet potato	0 -25	1.20 ± 0.37 a	0.60 ± 0.24 a
	26 -50	1.60 ± 0.40 a	1.80 ± 0.58 ab
	51-75	3.40 ± 0.51 b	3.20 ± 0.58 b
Ground nut	0 -25	1.60 ± 0.51 a	1.00 ± 0.31 a
	26 -50	1.60 ± 0.51 a	1.80 ± 0.49 a
	51-75	5.20 ± 1.2 b	4.40 ± 0.24 b

Means followed by the same letter are not significantly different at 5% level by Tukey's HSD.

Nest box occupied by owl

Nest box occupy mean the number owl enter into the nest box started for living. In Rajshahi 55 % nest boxes were occupied by owl whereas 50 % nest boxes were occupied by owl (Fig. 9). In Gazipur maximum nest box were occupied by spotted owlet (*Athene brama*) and in Rajshahi most of the nest box occupied by barn owl.

Examination of pellets from our and other study revealed that 70-80% of the barn owls diet is composed of rodents from agricultural fields and plantations (Tores *et al.,* 2005; Charter *et al.,* 2007). Browning *et al.* (2016) measured the effect of a population of barn owls on a rodent population in a 40-ha vineyard near Sacramento, California, USA. In First year 11 of 20 (55%) boxes were occupied by breeding pairs, fledging 40 young. In second year, 18 of 24 (75%) owl boxes were occupied, fledging 66 young; and in third year, three of 24 (12.5%) boxes were occupied, fledging nine young. Nocturnal observations revealed the owls hunted the study area heavily. Monthly pocket gopher surveys using the mound-count method indicated that gophers (rat species) declined on the vineyard with barn owl boxes relative to a control vineyard without barn owl boxes. Pellet analysis showed diet was composed mainly of Botta’s pocket gophers (70.4%) and California voles (26.2%). Using these figures, and adding conservative estimates of adult consumption over the 165-day breeding season, and adult and fledgling consumption prior to dispersal, the total number of preys taken over the three breeding seasons was 30,020 rodents indicating 30,020 rodents were reduced over three years of 40-hectare vineyard. The presence of barn owls is thus welcomed by farmers in Israel. Since the establishment of the pest control project, many farmers use barn owls as an alternative method of rodent control and thereby drastically reduce the use of rodenticides. The high occupancy of nest boxes by barn owls detailed in this study demonstrates, as also found in other studies throughout the world, that not only were natural nest sites lacking in the area, but also that nest boxes offer barn owls alternative nest sites, that can increase owl numbers in agricultural fields both for conservation and biological pest control aspects. Nest box orientation and habitation also affect the occupation of owl. Charte *et al.* (2010) studied the effect of exposure, orientation, and habitat on nest box occupation and breeding success of barn owls in a semi-arid environment. The occupation of nest boxes varied with exposure and orientation. A higher percentage of occupation and more barn owl nestlings per breeding attempt were found in nest boxes located in the shade than in the sun, and in those facing east/north rather than other directions. The temperature in the nest boxes varied, being lowest in those located in the shade and in those facing east. Nest boxes located in crop fields fledged younger per breeding attempt than those located in date plantations.

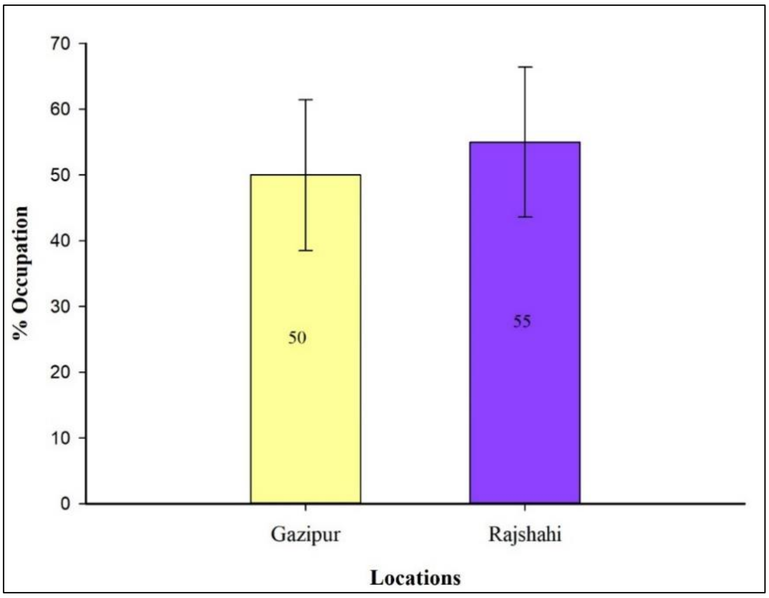

Fig. 9. Nest box occupation by owls as a function of exposure at two locations of Gazipur and Rajshahi.

Conclusion

Based on above results and discussion it is observed that rat damage and number of active burrows in different crop differed significantly from distance of watch tower. Comparatively lower rat damage and active burrows were recorded shorter distance to the watch tower compared to longer distance of watch tower. The percentages of nest box occupation in Rajshahi 55 % nest boxes were occupied by owl whereas 50 % were occupied by owl in Gazipur. Our results suggest owl nest boxes and watch tower could contribute meaningfully to integrated pest management of rats.

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