ANNUAL RESEARCH REPORT
2021-2022

VERTEBRATE PEST RESEARCH

Program Leader
Dr. Md. Shah Alam
Principal Scientific Officer

কৃষি গবেষণা

Vertebrate Pest Division
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701

Annual Research Report 2021-2022

Program Leader

Dr. Md. Shah Alam
Principal Scientific Officer

Compiled by

Dr. Md. Shah Alam, PSO
Dr. A.T.M. Hasanuzzaman, SSO

Vertebrate Pest Division
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701

Citation

Annual Research Report 2021-2022, Vertebrate Pest Division, BARI, Gazipur-1701

Editorial Committee

Dr. Md. Shah Alam, PSO
Dr. A.T.M. Hasanuzzaman SSO

Compilation

Dr. Md. Shah Alam, PSO
Dr. A.T.M. Hasanuzzaman SSO

Published by

Principal Scientific Officer
Vertebrate Pest Division
Bangladesh Agricultural Research Institute
Joydebpur, Gazipur-1701
Phone: +88-02-49270174
E-mail: pso.vert@bari.gov.bd

Published on

September, 2022

PREFACE

Vertebrate Pest Division is one of the unique divisions not only in Bangladesh Agricultural Research Institute but also in the country which deals research about vertebrate pest management. Animals having backbones that cause considerable amount of damage to crops and other commodities are called vertebrate pests. Vertebrate pests are the major problems both in the field and in storage. Every year, a huge amount of cereal crops especially rice and wheat, fruits and vegetables, storage products and other household things are damaged by different kinds of vertebrate pests. Vertebrate Pest Division was established in 1998 under BARI. The major research mandates of the division are; i) to identify different vertebrate pest species in Bangladesh and to determine their pest status, ii) to quantify the losses caused by them and iii) to develop appropriate methods or techniques to reduce losses. To meet the Sustainable Development Goal (SDG) by 2030, scientists of this division are trying to accelerate their research activities to develop sustainable and ecofriendly technologies to solve the vertebrate pest problems as well as to reduce the crop losses from 10 percent to 5 percent due to vertebrate pests' attack.

Vertebrate pests are generally categorized into three groups - rodents, birds, and jackals including other pest mammals. About 18 species of rats are found in Bangladesh. The lesser bandicoot (*Bandicota bengalensis*) and the greater bandicoot rat (*B. indica*), are found to be the major pests of rice and wheat. The roof rat (*Rattus rattus*) damages different fruits and vegetables specially coconut, guava etc. The house mice (*Mus musculus*) are found in the houses and cause damage to household things. It is reported that rat causes about 4-5% losses to rice (about 150000 ton), 8% in wheat (about 77000 ton), 4-6% in potato, 6-9% in pineapple, and about Tk.75,000 losses in post-harvest condition. Rats are also major problem in the poultry sector cause about Tk. 18000.00 losses per farm family per year. A total of crop damaged by the rats was estimated about Tk. 724 crore per year. Another pest is jackal that mostly damages sugarcane, water melon, maize etc. Squirrel is another rodent pest which is voracious eaters and diggers also. Generally, eight species of squirrels are found in Bangladesh of them brown squirrel (*Callosciurus phygerythrus*), five striped squirrel (*Funumbulus pennanti*), three striped squirrel (*F. palmarum*), and Malayan giant squirrel (*Rolufa bicolor*) are dominant. Squirrel mainly damage the fruits and vegetable crops but it also damages the cereals and household materials. The major bird species are the Indian myna (*Acridotheres tristis*), Pied myna (*Sturmus contra*), House crow (*Corvus splendens*), Jungle crow (*C. macrorhynchos*), Blue rock pigeon (*Columba livia*) etc. Bat is also an important vertebrate pest. About 3 species of bats are found in Bangladesh which cause extensive damage to banana, guava plantation, mango, litchi, and other fruits.

Scientists of Vertebrate Pest Division have developed different types of traps for controlling rat both in the fields and storage. They have also formulated a 2% zinc phosphide bait materials that has been recommended by the Government. This formulation of zinc phosphide is being successfully and widely used by the farmers. For repelling birds, different fungicides and insecticides can be used in the crop fields. Reflective ribbon is another technology to repel birds from the crop field. For protecting fruits from rats and squirrels, application of metal sheets around the tree trunk is very effective technology. We can also repel squirrel by spraying onion, green chilli and chilli dust upto 4-5 days. Sequential application of trapping followed by poison baiting more than 80 percent success can be achieved.

I am grateful to Almighty Allah and very much pleased to publish the Annual Research Report 2021-22 of Vertebrate Pest Division in time. This report covers the research activities that we conducted last in 2020- 21. Last year we conducted seven experiments and all the research activities have been printed in this report.

Finally, I would like to acknowledge all the scientists, scientific assistants, laboratory assistants and office staffs for their great contribution for conducting the experiments and preparing this annual research report successfully and timely.

Dr. Md. Shah Alam
Principal Scientific Officer

Research Highlights (2021-2022)

- The efficacy of low-dose (25ppm) anticoagulant based rodenticide bait compared to high-dose (50ppm) anticoagulant based rodenticide bait in *Bandicota bengalensis*, the common rodent species of Bangladesh. Rat consumed lower amount of low-dose (25ppm) brodifacoum (0.89g/rat/day) and low-dose (25ppm) bromadiolone (1.31g/rat/day) whereas the rat consumption of commonly used high-dose (50ppm) bromadiolone (lanirat) was 4.78 to 6.08 g/rat/day. In laboratory condition, the low-dose (25ppm) bromadiolone showed 50% success in rodent control whereas low-dose (25ppm) brodifacoum showed only 40% success.

- Three plant oil i.e. eucalyptus, neem and mehogoni as rodent repellant. Food was offered to rats at different distance from the oil odor source and their consumption was recorded. All plant oils showed the similar repellence against rat feeding where those can repel rat up to 3 days from their food. Rat consumed significantly lower amount of food from within 1m distance (0-2.63 g/rat/day) of oil source compared to 6m distance (5.76-12.09 g/rat/day). At up to 1m distance of eucalyptus oil source, rat consumed 1.26-2.25 g food per day where as it was 1.32-1.58 g for neem oil and 1.47-2.63g for mehogoni oil.

- Comparative efficacy of newly designed kill trap and commonly used live and kill trap were evaluated. The efficacy of newly designed snap trap and commonly used live and snap trap were statistically similar in both enclosure and field-test. In enclosure test, the average success of newly designed snap trap and commonly used live trap was 40.00% and 32.00% respectively whereas commonly used kill trap showed only 28.00% success. In field, the average success of newly designed snap trap and live trap was 43.90% and 38.00% respectively whereas commonly used kill trap showed 28.05% success.

- Four different wrapping materials i.e. butter paper, para film, tree leaf and writing paper were evaluated for poison baiting inside the wet burrow and rodent control success was recorded. Highest success was observed with writing paper (49.43%) wrapped poison baiting which was statistically similar with bamboo leaf (45.71%) and butter paper wrapping (31.50%). Lowest success was found in case of para film (29.71%) wrapped poison baiting.

- A survey was conducted among the farmers on squirrel problem in Four upzilla of Cumilla district namely Chandina, Barura, Burichang and Debidwar were selected for this study. All the upazilla of Cumilla district farmers reported two types of squirrels which were brown and striped whereas brown was pre dominant in Cumilla. According to the farmers' opinion, vegetables and fruit crops were frequently damaged by the squirrels. Most affected vegetable crops were bean (50%) followed by bottle gourd (40%) Ridge gourd (18.33%) and pumpkin (16.67%). Among the fruit crops maximum damage was found in coconut (44.16%), followed by Guava (46.7%) ber (28.3%), betelnut (29.16%) and and mango (22.5%). Farmers reported that average Tk. 500-1000 per family per year was lost in case of vegetables damaged by squirrel while it was more than Tk. 1000 in case of fruits. Maximum damage was occurred at full grown stage (51.67%) followed by all stage (26.67%) of the crop in all the season. Farmers were unknown about the breeding frequency, breeding season and number of young per parturition. Most popular control method used by the farmers was cage Trapping (46%) followed by snap trapping (29%) poison (12%).

- Efficacy of different repellent techniques on sunflower against pest birds were evaluated. Four treatments viz., Multicolour reflective ribbon, Plastic bottle wind mill, four side netting, and Untreated control (without repellent) were used in this experiment. It was revealed that significantly maximum damage of sunflower caused by the pest birds were in the control plots compared to netting treated plots. In control plots maximum 54.5% head damage and 62.5% plant damage were happened by the birds whereas the lowest damage was happened in treatment where whole plot covered by net (0%) treated plots and two side netting treated plot (2.5%). Fourteen birds species were recorded in sunflower belonging to 14 families and 6 orders during the study periods from dawn to dusk. Passeroformes was the most dominant order (57%) represented 6 families and species followed by order Collumbiformes (2 families 2 species). However, the species richness and Diversity of bird species were obtained higher in morning (14) and noon (9) than afternoon (7).

- ❖ Field efficacy of three rodenticide viz. Bromadon, Rat Finix (Bromadiolone) and Ratkil (Zinc phosphide) supplied from company.,‘were evaluated. In field trial test all the rodenticide showed more than 80% rodent control success was recorded. The average poison bait consumption was 1.0 to 1.17 g/rat/day in all the tested bait.

C O N T E N T S

Research Report 2021-2022

EFFICACY OF RODENTICIDE BAITS WITH DECREASED CONCENTRATION OF BROMADIOLONE AND BRODIFACOUM

A.T.M. Hasanuzzaman and M. S. Alam

Abstract

The experiment was conducted at vertebrate pest division laboratory, BARI in 2021-2022 to evaluate the efficacy of low-dose (25ppm) anticoagulant based rodenticide bait compared to high-dose (50ppm) anticoagulant based rodenticide bait in *Bandicota bengalensis*, the common rodent species of Bangladesh. Rat consumed lower amount of low-dose (25ppm) brodifacoum (0.89g/rat/day) and low-dose (25ppm) bromadiolone (1.31g/rat/day) whereas the rat consumption of commonly used high-dose (50ppm) bromadiolone (lanirat) was 4.78 to 6.08 g/rat/day. In laboratory condition, the low-dose (25ppm) bromadiolone showed 50% success in rodent control whereas low-dose (25ppm) brodifacoum showed only 40% success.

Introduction

Rodent is the serious vertebrate pest in Bangladesh agriculture. It causes serious damage to our crops in the field and in storage. According to Ahmed *et al*. (1986) rat cause 5.7 % losses to deep water rice, and Sultana & Jaeger (1992) described wheat and rice losses as 2.3 and 1.9 % of the expected yields in two areas of Bangladesh between 1986 and 1988 respectively. Rats are major problem in the poultry sector too. They share the poultry food from the food tray, damage the eggs, chicken and also destroy the food in the storages. They damage the floor of the farm by extensive burrowing and also attack the young birds (Roy *et al*., 1987) and disseminate different kinds of diseases.

In Bangladesh, farmers commonly use zinc phosphide, aluminum phosphide and lanirat (50 ppm bromadiolone) to control rodents. Trapping and flooding the burrows are also common practice among the farmers. Zinc phosphide bait is effective poison but creates bait shyness and also creates environmental pollution. Bait shyness problem that occur in zinc phosphide poisoning was solved by the introduction of anticoagulant poison. In anticoagulant, rat does not associate poisoning symptoms with the bait material. As a result, complete control of rodent population is possible with anticoagulant poison. Recently, second generation single dose anticoagulant rodenticides like bromadiolone and brodifacoum are found very effective against many rodent species (Brooks, *et al*., 1974; Mathur and Prakash, 1981, Chopra *et al*., 1983; Buckle *et al*, 1984, Prashad *et al*, 1985).

Anticoagulants are the most commonly used rodenticide at the global scale. Because of their persistency, bioaccumulation and potential of secondary intoxication, they have faced increasing legislative regulations. Recently, European Union Regulation (EU) 2016/1179 resulted in the production and application of rodenticides with nearly half dose (below 30 ppm) of anticoagulants. However, published data on the biological efficacy of rodenticides with decreased doses are scarce. In this experiment, we shall compare the efficacy of the original high-dose (50 ppm) and new low-dose (25 ppm) bromadiolone based bait in *Bandicota bengalensis*, the common rodent species in Bangladesh. The objective of the study was to find out highly effective and safe doses of anticoagulant rodenticides for controlling rodents.

Material and methods

The experiment was conducted in the laboratory of Vertebrate Pest Division, BARI, Gazipur during 2021-22. Two types of low-dose (25ppm) anticoagulant rodenticides were collected from a rodenticide company. These were 25ppm brodifacoum and 25ppm bromadiolone. It is stated that bromadiolone is widely used highly effective rodenticide in Bangladesh. The commonly used high- dose (50ppm or 0.005%) bromadiolone is formulated with wheat grain i.e. the main carrier material is wheat grain (about 100%). But the composition of low-dose (25ppm) brodifacoum is 0.0025% brodifacoum, 0.001% denatonium benzoate and non-active substances (up to 100%). The composition of low-dose (25ppm) bromadiolone is 0.0025% bromadiolone, 0.001% denatonium benzoate and non-active substances (up to 100%). The non-active substances are not disclosed here but those were looked like wax like material. Choice feeding test was conducted for this study. Bandicoot rats, *Bandicota bengalensis* (Gray), were collected from rat breeding house of Vertebrate Pest Division laboratory and these rats were used as test animal. Rats were kept in 40 X 25 X 18 cm rearing cage in the laboratory.

Choice test: Two types of choice tests were conducted, one is choice between low-dose anticoagulant and plain wheat grain another is choice between low-dose anticoagulant and commonly used high-dose (50ppm) anticoagulant i.e. lanirat. The choice feeding tests were conducted in the laboratory using 20 (10 males and 10 female) acclimatized adult rats in each sample. Six hours starved rats were exposed individually to poison bait in a food cup for 24 hours. Two food cups were provided to each animal, one cup containing 20g of poison bait and the other containing 20g of plain wheat grains for each sample. Rodenticide was supplied for three consecutive days and the plain wheat grain was provided up to end of the experiment (up to 15 days). Spilled bait material or wheat grains were collected in a paper placed beneath the cages and weighted in both the tests. Water was supplied at *ad libitum*. Consumption of bait material or food and mortalities of the test rats were recorded every day.

Result and Discussion

Consumption of 25 ppm brodifacoum and plain what grain is presented in fig. 1. It is observed that the consumption of rat was significantly differed between 25 ppm brodifacoum and plain wheat grain ($t= 9.84$, $p \leq 0.01$). The consumption of plain wheat grain was 6.98g/rat/day whereas it was only 0.89g/rat/day in case of 25 ppm brodifacoum. Similar result was found in case of rat consumption between 25 ppm brodifacoum and lanirat (fig. 2). Rat consumption was differed significantly between 25 ppm brodifacoum and lanirat ($t= 6.127$, $p \leq 0.01$). The consumption of lanirat was 4.78 g/rat/day whereas the consumption of 25 ppm brodifacoum was only 1.45g/rat/day.

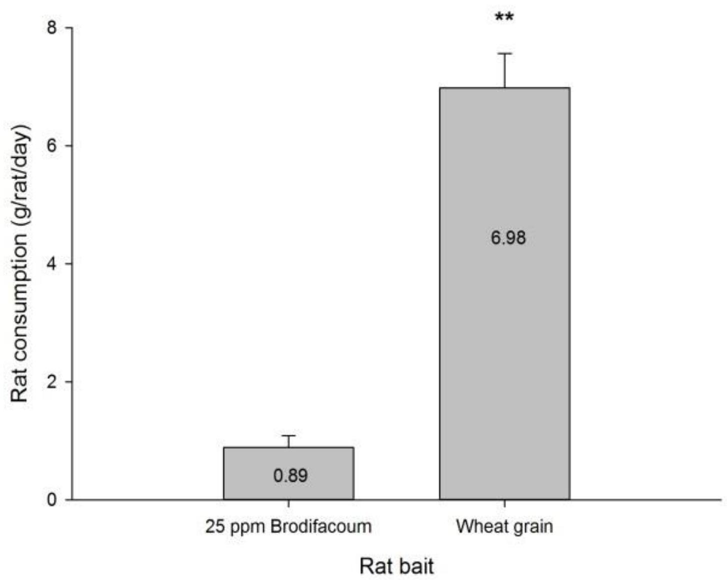

Fig 1. Rat consumption of 25ppm brodifacoum in choice feeding test with plain wheat grain in laboratory.

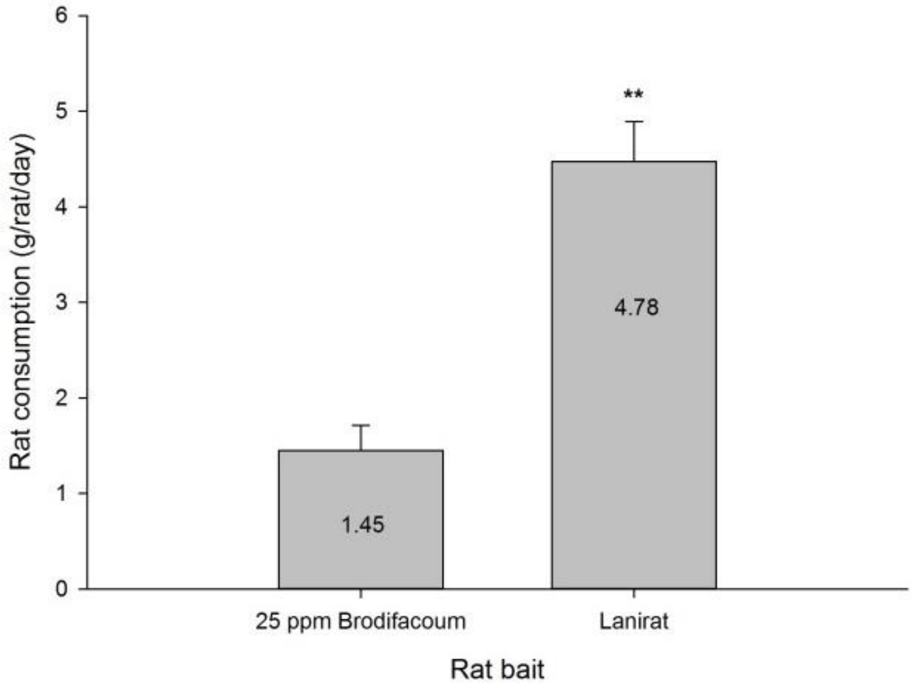

Fig 2. Rat consumption of 25ppm brodifacoum in choice feeding test with lanirat (50ppm bromadiolone) in laboratory.

Consumption of 25 ppm bromadiolone and plain what grain is presented in fig. 3. It is observed that the consumption of rat was significantly differed between 25 ppm bromadiolone and plain wheat grain (t= 6.829, p≤0.01). The consumption of plain wheat grain was 6.26g/rat/day whereas it was only 1.31g/rat/day in case of 25 ppm bromadiolone. Similar result was found in case of rat consumption between 25 ppm bromadiolone and lanirat (fig. 4). Rat consumption was differed significantly between 25 ppm bromadiolone and lanirat (t= 2.867, p≤0.01). The consumption of lanirat was 6.08 g/rat/day whereas the consumption of 25 ppm bromadiolone was only 2.6g/rat/day. Wheat grain is very good food for rodent, that's why its consumption was higher than the poison. Even the consumption of lanirat (50ppm bromadiolone) was also higher than the low-dose brodifacoum (25ppm). The formulation of commonly used lanirat (50ppm bromadiolone) and low-dose anticoagulants (25ppm) are not same. In lanirat, wheat was used as carrier material but in low-dose anticoagulant's carrier material was wax like material. These may be the causes of lower consumption of low-dose anticoagulants.

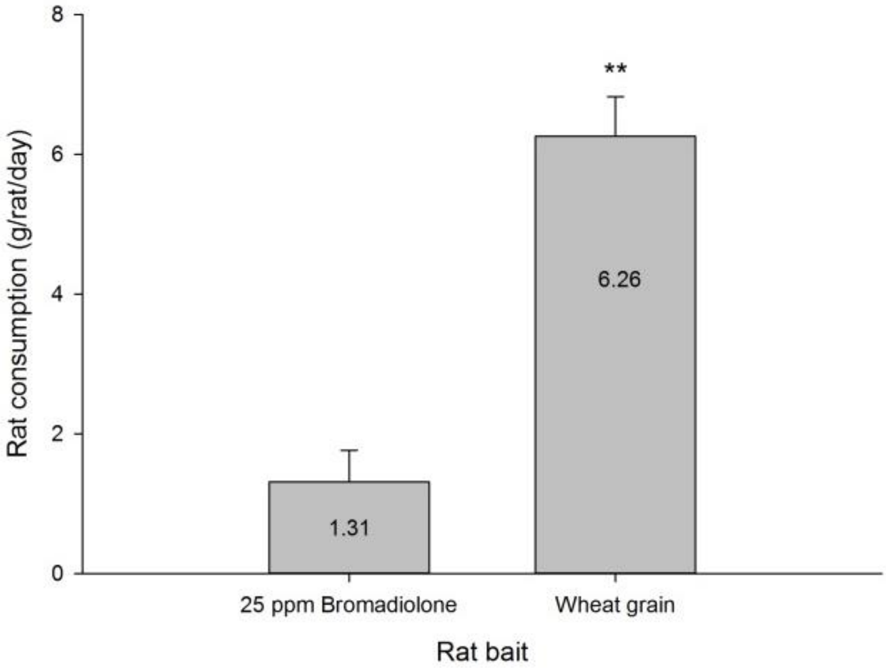

Fig 3. Rat consumption of 25ppm bromadiolone in choice feeding test with plain wheat grain in laboratory.

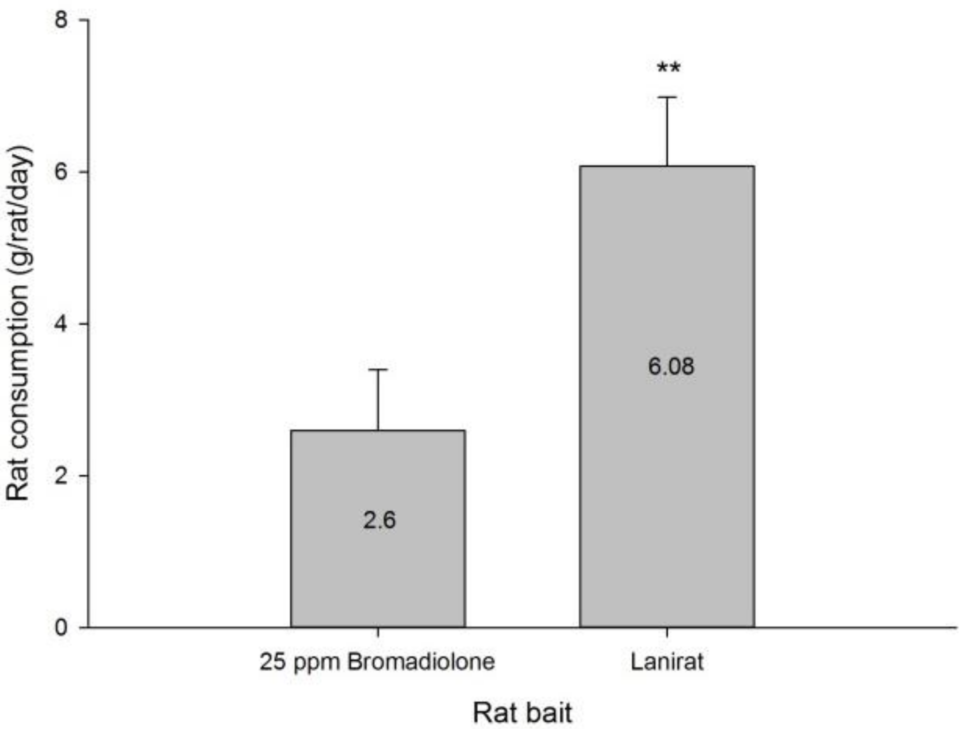

Fig 4. Rat consumption of 25ppm bromadiolone in choice feeding test with lanirat (50ppm bromadiolone) in laboratory.

The comparative efficacy of 25 ppm brodifacoum and 25 ppm bromadiolone in rodent control is presented in fig.5. Unfortunately no significant difference was found in between the two anticoagulant rodenticides (t=0.429, p=0.673). Bromadiolone (25ppm) showed 50% rodent mortality whereas only 40% rodent mortality was found in case of 25 ppm brodifacoum. Bromadiolone is very good anticoagulant rodenticide that is wide used in Bangladesh. From our previous study, it was observed that original-high dose (50ppm) bromadiolone showed about 100% rodent mortality in laboratory condition, even it showed more than 90% success in field condition. But in this experiment, low-dose anticoagulants (25ppm) did not show the good result. It may be due to its lower dose of poison. In another experiment, Frankova *et al*. (2019) found 95.7% to 99.8% rodent mortality in field level using low-dose brodifacoum (25ppm). This result was inconsistent with ours. In case of mortality test, we used smaller bandicoot rat (*Bandicota bengalensis*) as a test animal but in their study, they used house mice (*Mus musculus* L.) as a test animal. Besides, the low-dose (25ppm) anticoagulants are not formulated by our laboratory. We collect it form a pesticide company. We did not test its chemical purity. These may be the cause of lower success of low-dose (25ppm) anticoagulants in our laboratory. From this study, it can be concluded that the low-dose (25ppm) anticoagulant did not show satisfactory result for controlling bandicoot rat *Bandicota bengalensis* in laboratory.

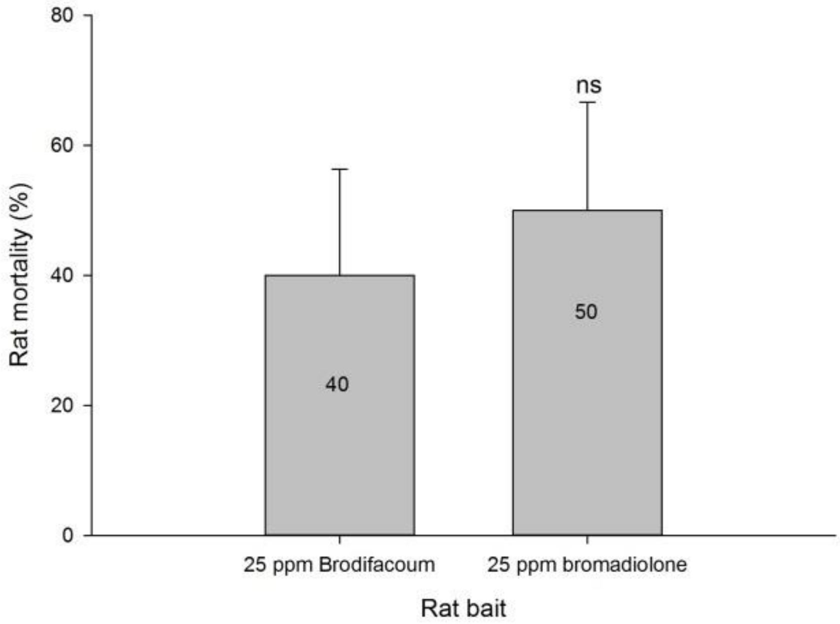

Fig 5. Comparative efficacy of low-dose anticoagulants i.e. 25ppm brodifacoum and 25ppm bromadiolone in rodent control in laboratory.

References

Ahmed, M.S., Mian, M.Y, Haque, M. E & Brooks, J.E 1986. Estimating rat damage in deep water rice. Int. Rice Res. Newsl, 11(1), 23-24.

Brooks, J.E., Pethan, H., Hla, N., walton, D.W., and Maung, M.T. 1979. Laboratory evaluation of rodenticides for use against South-East Asian commensal small mammals. World Health Organisation WHO/VBC/79. 720.

Buckle, A.P., Rowe, F.P., and Husin, A.R. 1984. Field trials of warfarin and brodifacoum wax block baits for the control of the rice field rat, Rattus agentiventer, in Penninsular Malaysia. Tropical Pest Management. 30, 51-58.

Chopra, G., Ahmad, N., and Prashad, V.R. 1983. Laboratory evaluation of supercaid (Bromadiolone) against three murid species. Indian journal of Plant Protection 11, 70-73.

Frankova, M; V Stejskal & R Aulicky. 2019. Efficacy of rodenticide baits with decreased concentrations of brodifacoum: Validation of the impact of the new EU anticoagulant regulation. Scientific reports. 9:16779.

Hasanuzzaman, A T M, M.Y. Mian and M.S. Alam., 2004. Rodent species composition and their control in poultry farm. Bangladesh J. entomol. 14(2), 61-67.

Mathur, R.P. and Prakash, J. 1981. Evaluation of brodifacoum against Tatera indica, Mariones hurrianae and Rattus rattus. Journal of Hygiene, Cambridge. 87, 178-184.

Prashad, V.R., Ahmad, N. and Chopra, G. 1985. Laboratory and field evaluation of brodifacoum for rodent control. International Biodeterioration 21, 107-112.

Roy, L.G., Singh R.K.T. and Singh, K.D. 1987. Rodent control in poultry farm near Imphal, Monipur, using Bromadiolone. Rodent Newsletter. 11(1-4), 6-8.

Sultana, P & Jaeger, M. M. 1992. Control strategies to reduce preharvest rat damage in Bangladesh. In: proc. 15 the Vertebr. pest conf. Newport Beach, california. 15, 261-267.

EVALUATION OF SOME PLANT OILS AS REPELLENT AGAINST RODENTS

A T M Hasanuzzaman and M S Alam

Abstract

The experiment was conducted in outdoor rat enclosure at vertebrate pest division in BARI, Joydebpur, Gazipur during 2021-22 to evaluate three plant oil i.e. eucalyptus (*Eucalyptus saligna*), neem (*Azadirachta indica*) and mehogoni (*Swietenia mahagoni*) as rodent repellant. Food was offered to rats at different distance from the oil odor source and their consumption was recorded. Eucalyptus and neem plant oils showed the similar repellence against rat feeding where those can repel rat up to 3 days from their food. Rat consumed significantly lower amount of food from within 1m distance (0-2.90 g/rat/day) of oil source compared to 6m distance (1.98-12.42 g/rat/day). Up to 3 observational days, at 1m distance of eucalyptus oil source, rat consumed 1.25-2.24 g/rat/day where as it was 1.30-1.69 g/rat/day for neem oil.

Introduction

There is no doubt that rat is a deadly enemy for the agriculture of Bangladesh. Rodents are often a serious threat of different crops and household materials throughout Southern Asia causing damage from 3.5 to 6.8%, depending on crop species. Especially it can damage huge amount of grain crops. The damage cause in the rain-fed deep water rice was assessed as high as 6.8% in 1987 and 3.2% in 1988 (Islam *et al*., 1993). In wheat, damage ranged from 3.5 to 12% (Bindra and Sagar, 1968; Sood and Guraya, 1976; Poche *et al*., 1979; Ahmad, 1986). Poison baiting and trapping are the most common rat control methods in Bangladesh. Farmers commonly used zinc phosphide and bromadiolone as poison bait for controlling rodent. Locally available snap trap (kachi kall) and live trap are also used for trapping rodents. Trapping alone is not very effective method for controlling rodent. Sometimes farmers use their indigenous techniques to combat the rat attack but success is not as expected. Some tribal people take rat as a food but it can’t be a common rodent controlling option in Bangladesh due to religious restriction.

In Bangladesh farmers generally prefer zinc phosphide baiting for controlling rodent compared to anticoagulant as it is costly. But it induces bait shyness making the bait less acceptable to rodents (Barnett and Prakash, 1975). Others researchers have also reported bait acceptance problems related to bitter taste of zinc phosphide or sub-lethal illness and subsequent conditioned aversion after rodents ingest minimal level of bait (Sridhara 1983, Prakash and Ghosh 1992, Reidinger 1995). Effect of bait shyness may persist more than a year even zinc phosphide removed from the bait. Rodents have extreme or irrational fear or dislike of anything new or unfamiliar due to its neophobic character. Rodents generally avoid consuming some rodenticide bait with an appropriate dose due to its unpleasant taste and smell. Natural products represent one of the most important alternatives to control pests and diseases that affect plants and animals without deleteriously affecting environmental safety (Islam 1997, Men and Hall 1999, Tripathi *et al*., 2008). Plants with strong smells act as repellents and can protect the crops nearby (Firouzi et al. 1998, Khater 2011, Dubey *et al*. 2011). Singla and Parshad (2007) studied the antifeeding effects of neem-based formulation against R. rattus. Kalandakanond-Thongsong *et al*. (2010) evaluated the efficacy of chilli, wintergreen oil, bergamot oil, peppermint oil, and geranium oil as repellents in the circular open field against adultmale Wistar rats. Pine needle oil inhibits feeding in vertebrate species through sensory cues (Wager-Page *et al*., 1995). Some botanicals also have anti-reproductive effects against pests (Singla and Garg, 2013) while some have positive effects on growth (Djakalia *et al*., 2012).

Among the plant families with promising essential oils used as repellents include Cymbopogon spp., Ocimum spp., Thymus spp., and Eucalyptus spp. (Koul *et al*., 2008). Among essential oils, eucalyptus oil, in particular, is more useful as it is easily extractable commercially (industrial value) and possesses a wide range of desirable properties worth exploiting for pest management (Barton, 2000). Rodent repellents are chemicals which by taste or odor or possibly by both will prevent animal from feeding or gnawing. Such substances may be used in protecting an area as well as a tree from rodent infestation or in protecting packaged food, packing materials, electric cables, and other important vulnerable materials. Relatively little work has been carried out on plant-derived repellents compared to other aspects of rodent control. For management purposes, it could be helpful to find repellents that are species-specific and do not affect non-target species. The objective of the study was to find out an effective rodent repellent to minimize crop losses due to rodents.

Materials and Method:

The experiment was conducted at the laboratory and inside the rodent enclosure of Vertebrate Pest Division. BARI, Gazipur. Lesser Bandicoot rat, *Bandicota bengalensis* was used as test animal. The animals were kept under the laboratory condition for at least 3 weeks for acclimatization before starting the experiment. All animals were starved for 6 hours before applying the treatment. The trials were conducted in September 2021 to April 2022 at four outdoor rat enclosures in vertebrate pest division.

The source of repellent and baiting:

Three plant oil viz. eucalyptus (*Eucalyptus saligna*), neem (*Azadirachta indica*) and mehogoni (*Swietenia mahagoni*) were evaluated as rodent repellent. Three outdoor rodent enclosures, were considered as three observations were used for each plan oil. A twig of cotton was put in a metallic food cup that was placed at one corner of enclosure. One drop of plant oil was provided on the cotton twig which was considered as repellent odor source. Four more food cups were placed at 1 cm, 50 cm, 1 m and 6 m distances from the odor source. Wheat grain was used as rat bait. Rodent repellency of specific plant oil at several distances was tested in each enclosure in a multi-choice situation. The positions of the bait stations in each set were changed every day to avoid rodents developing place preferences and to control for any effect of position on choice of bait station but the distances from the odor source were maintained strictly. Three mature male rats were released in to the enclosure. Hundred grams of bait was placed in each bait station each evening and the amount removed was measured by weighing the amount of bait left over in each bait station on the day of observation. Bait stations were refilled for 6 consecutive days. Repellency effect of the oils was assessed based on food consumption.

To correct the day to day effect of air humidity and moisture contents on the weight of grains, a measured amount of bait was placed in separate bait boxes kept out of reach of rodents, as control samples. This bait was weighed daily to check any gain or loss of weight due the air humidity. This correction was applied calculating the actual consumption of bait by rodent from each bait station.

Result and Discussion

Eucalyptus oil: The daily food taken by rat from different bait station at different distances from the odor source were differed significantly for up to three days (1st day: $F_{3,8}$ = 107.258, $P < 0.001$; 2nd day: $F_{3,8}$ = 51.754, $P < 0.001$; 3rd day: $F_{3,8}$ = 34.002, $P < 0.001$) but no significant differences were found for the consumptions of remaining days (4th day: $F_{3,8}$ = 3.586, $P = 0.66$; 5th day: $F_{3,8}$ = 1.287, $P = 0.350$; 6th day: $F_{3,8}$ = 3.357, $P = 0.76$). The average amounts of daily food taken by rat at different distances from the odor source are shown in Fig. 1. At 1st observation day, no food was taken from 1cm distance that was statistically similar with 50 cm distance (0.89 g/rat/day) but different with 1 m distance (1.27 g/rat/day). Highest amount of food (11.00 g/rat/day) was consumed from 6 m distance from the odor source. Similarly, at 2nd and 3rd observational days, the highest amount of food was consumed by rat from the 6 m distance (2nd day: 12.33 g/rat/day, 3rd day: 9.68 g/rat/day). The lowest amount of food was taken from 1 cm distance (2nd day: 0.08 g/rat/day, 3rd day: 0.69 g/rat/day) of odor source which was statistically similar with 50 cm (2nd day: 1.01 g/rat/day, 3rd day: 1.91 g/rat/day) and 1m (2nd day: 1.42 g/rat/day, 3rd day: 2.24 g/rat/day) distance. At 4th and 5th observation day, comparatively lower amount of food was taken from 1m than 6m distance but the different was not significant. From 6th observation day, the amount of food consumption by rat was more or less similar at all distance from the odor source. In another experiment Singla *et al*. (2014) found 5 % eucalyptus oil as potential repellent of male *Rattus rattus* in India. On the other hand, the daily total food consumption by rat did not differ significantly ($F_{5,12}$ = 0.569, $P = 0.723$) without considering the food distance from the odor source (Fig. 2).

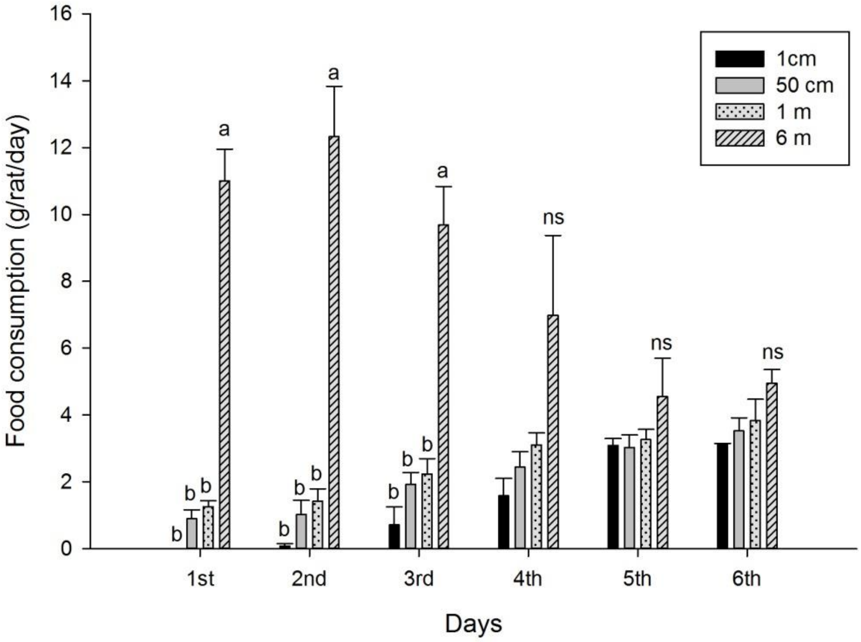

Fig. 1. Average daily food consumption by rat at different distances from eucalyptus oil odor source for six consecutive days in vertebrate pest division, BARI, Gazipur.

Similar letters show non-significant difference to each other.

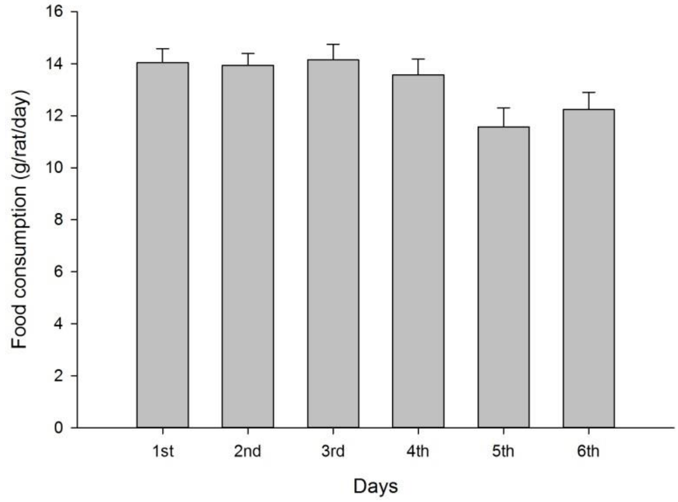

Fig. 2. Average daily total food consumption by rat with eucalyptus oil odor source for six consecutive days in vertebrate pest division, BARI, Gazipur.

Neem oil: The daily food taken by rat from different bait station at different distances from the odor source were differed significantly for up to four days (1st day: $F_{3,8}$ = 814.523, $P < 0.001$; 2nd day: $F_{3,8}$ = 65.643, $P < 0.001$; 3rd day: $F_{3,8}$ = 246.118, $P < 0.001$; 4th day: $F_{3,8}$ = 13.287, $P < 0.01$) but no significant differences were found for the consumptions of remaining days (5th day: $F_{3,8}$ = 0.513, $P = 0.685$; 6th day: $F_{3,8}$ = 1.241, $P = 0.357$). The average amounts of daily food taken by rat at different distances from the odor source are shown in Fig. 3. At 1st observation day, no food was consumed from 1cm distance and very small amount of food (0.73g/rat/day) was taken from 50 cm distance that was statistically similar with 1m distance (1.30 g/rat/day). Highest amount of food (12.42 g/rat/day) was consumed from 6 m distance from the odor source. Similarly, at 2nd and 3rd observational days, the highest amount of food was consumed by rat from the 6 m distance (2nd day: 11.20 g/rat/day, 3rd day: 10.69 g/rat/day). The lowest amount of food was taken from 1 cm distance (2nd day: 0.17 g/rat/day, 3rd day: 0.56 g/rat/day) of odor source which was statistically similar with 50 cm (2nd day: 0.86 g/rat/day, 3rd day: 1.5 g/rat/day) and 1m (2nd day: 1.69 g/rat/day, 3rd day: 1.54 g/rat/day) distance. Although significantly higher amount of food was taken by rat at 6 m distance on 4th day from the odor source but the difference is not so high compare to other distances. From 5th observation day, the amount of food consumption by rat was more or less similar at all distance from the odor source. On the other hand, the daily total food consumption by rat did not differ significantly ($F_{5,12}$ = 3.146, $P = 0.048$) without considering the food distance from the odor source (Fig. 4).

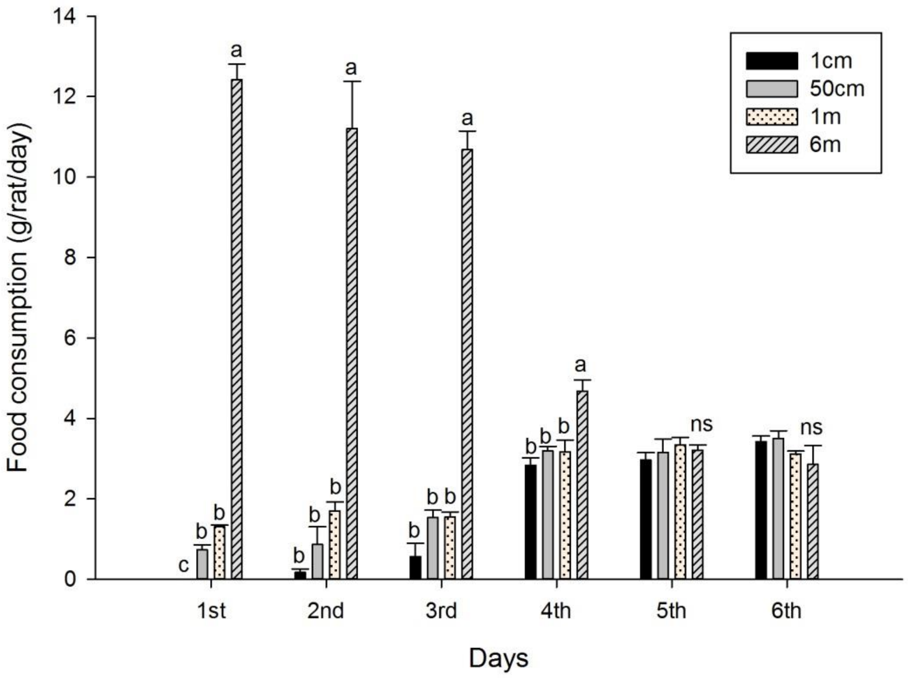

Fig. 3. Average daily food consumption by rat at different distances from neem oil odor source for six consecutive days in vertebrate pest division, BARI, Gazipur.

Similar letters show non-significant difference to each other.

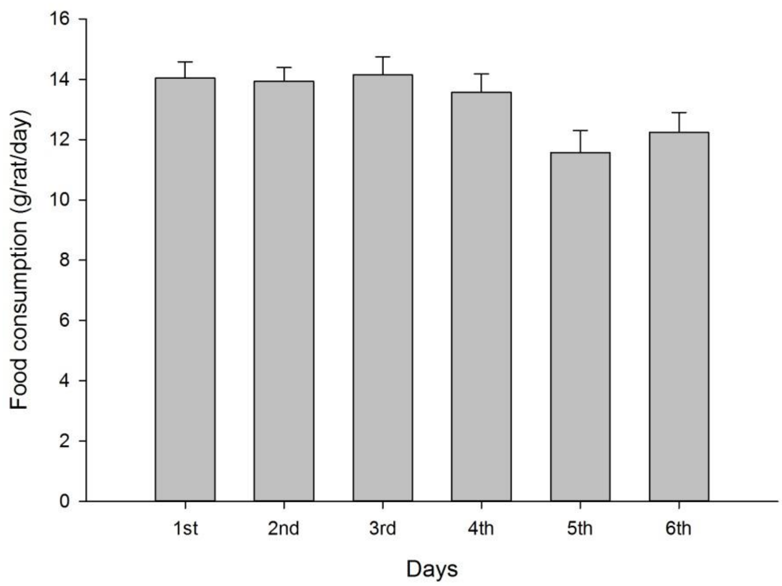

Fig. 4. Average daily total food consumption by rat with neem oil odor source for six consecutive days in vertebrate pest division, BARI, Gazipur.

Mehogoni oil: The daily food taken by rat from different bait station at different distances from the odor source were differed significantly on 1st observational day ($F_{3,8}$ = 21.013, $P < 0.001$) but no significant differences were found for the consumptions of remaining days (2nd day: $F_{3,8}$ = 2.636, $P = 0.121$; 3rd day: $F_{3,8}$ = 0.028, $P < 0.993$;4th day: $F_{3,8}$ = 0.267, $P = 0.847$; 5th day: $F_{3,8}$ = 2.257, $P = 0.159$;

6th day: $F_{3,8}$ = 0.225, $P = 0.876$). The average amounts of daily food taken by rat at different distances from the odor source are shown in Fig. 5. At 1st observation day, the lowest amount of food (0.833 g/rat/day) was taken from 1cm distance that was statistically similar with 50 cm distance (1.03 g/rat/day) and 1 m distance (1.84 g/rat/day). Highest amount of food (9.58 g/rat/day) was consumed from 6 m distance from the odor source. From 2nd to 6th observation day, the amount of food consumption by rat was more or less similar at all distance from the odor source. On the other hand, the daily total food consumption by rat did not differ significantly ($F_{5,12}$ = 1.236, $P = 0.351$) without considering the food distance from the odor source (Fig. 6).

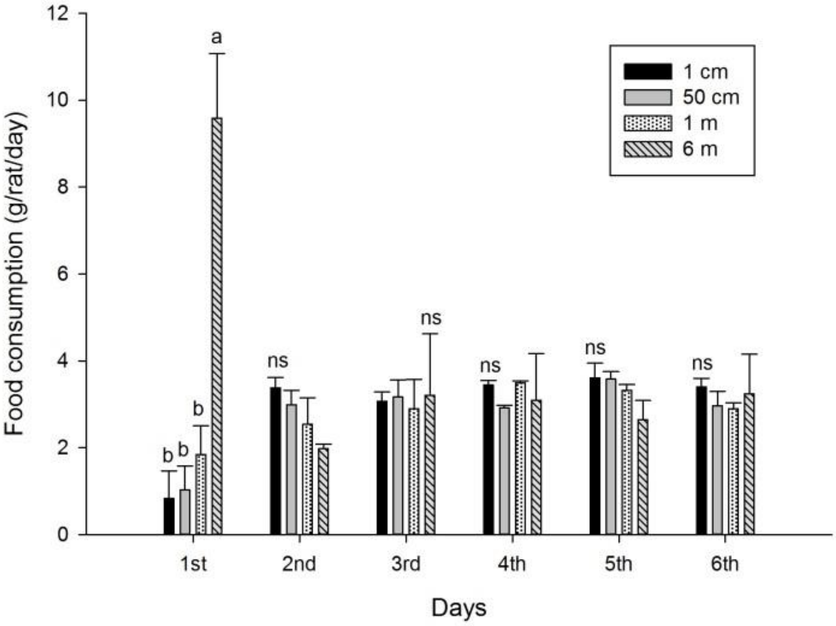

Fig. 5. Average daily food consumption by rat at different distances from mehogoni oil odor source for six consecutive days in vertebrate pest division, BARI, Gazipur.

Similar letters show non-significant difference to each other.

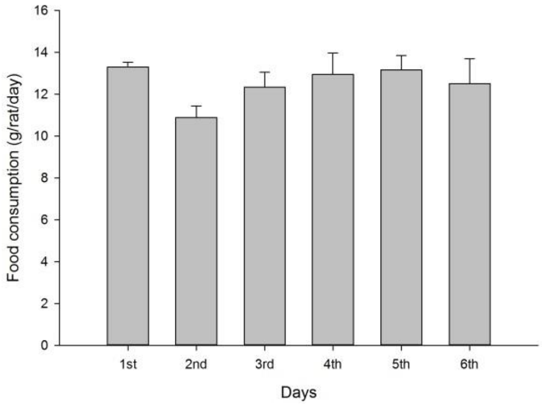

Fig. 6. Average daily total food consumption by rat with mehogoni oil odor source for ten consecutive days in vertebrate pest division, BARI, Gazipur

During the present studies, significant differences were found in mean daily food consumption by rat at up to 1m and 6m distance of two oil sources i.e. eucalyptus and neem oil for three days. But in case of mehogoni oil source, significant differences were found in mean daily rat food consumption at up to 1m and 6m distance for one day only. The two plant oil viz. eucalyptus, and neem oil can repel rat from their food for up to three days. Highest repellency was observed in shortest distance of oil source. Further study is needed to confirm this result. Sex specific response of specific oil should be studied in future.

References:

Ahmad, N., 1986. Studies on rodent pest management in agro and forest ecosystems. Unpublished PhD thesis, Garhwal University,Srinagar.

Barnett, S. A. and I. Prakash., 1975. Rodents of economic importance in India, pp.1-175. New Delhi and London: Arnold-Heinemann.

Barton, A. F. M. 2000. The oil mallee project: a multifaceted industrial ecology case study. Journal of Industrial Ecology, 3 (2-3), pp. 161–176.

Bindra, O. S. and P. Sagar., 1968. Study on the losses to wheat, groundnut and sugarcane crops by the field rats in Punjab. Proceedings of the International Symposium on Bionomics and Control of Rodents, pp.28-31.Kanpur, India.

Djakalia B., B. L. Guichard, andA. E. Fernande 2012. Effect of palm oil and soya bean oil on growth performance and health of rabbit before and after weaning," Journal of Applied Animal Research, 40(1), pp. 56–60.

Dubey N. K., R. Shukla, A. Kumar, P. Singh, and B. Prakash, 2011. "Global scenario on the application of natural products in integrated pest management programmes," in Natural Products in Plant Pest Management, N. K. Dubey, Ed., vol. 1, pp. 1–20, CAB International.

Firouzi R., M. Azadbakht, and A. Nabinedjad 1998. Anti-listerial activity of essential oils of some plants," Journal of Applied Animal Research, vol. 14, no. 1, pp. 75–80.

Islam, Z., Morton, R.G. and Jupp, B.P. 1993. The effect of rat damage on deepwater rice yields in Bangladesh. International Journal of Pest Management. 39:250-254.

Isman M. B., 1997. Neem and other botanical insecticides: barriers to commercialization, Phytoparasitica, 25(4), pp. 339–344.

Kalandakanond-Thongsong S., S. Daendee, B. Thongsong, and V. Chavananikul. 2010. The efficacy of pure natural repellents on rat responses using circular open field, Thai Journal of Veterinary Medicine, 40(4), pp. 411–418.

Khater, H. F. 2011. Ecosmart biorational insecticides: alternative insect control strategies, in Advances in Integrated PestManagement, F. Perveen, Ed., pp. 17–60, InTech, Rijeka, Croatia.

Koul O., S. Walia, and G. S. Dhaliwal, 2008. Essential oils as green pesticides: potential and constraints. Biopesticide International, 4(1). 63–84.

Men J. and F. Hall, 1999. Biopesticides: present status and future prospects, in Methods in Biotechnology: Biopesticides: Use and Delivery, F. Hall and J. Menn, Eds., vol. 5, pp. 1–10, Humana Press, Totowa, NJ, USA.

Poche, R.M., M.Y.Mian, M. E.Haque, D. Mian, A.I.Mannan, A.II. Mannan and Sultana, P., 1979. Rodent damage to wheat in Bangladesh. Special Report No. 1 Bangladesh Agricultural Research Institute. Vertebrate Pest Division.

Prakash, I, and P. Ghosh, (editors). 1992. Rodents in Indian Agriculture, Vol.,Scientific Publishers, Jodhpur, India.

Redinger, R. F. Jr. 1995. Recent studies on flavor aversion learning in wildlife damage management. Pages 10l -120 in J. R. Mason. editor. Repellents in Wildlife Management: Proceedings. Colorado State University: Fort Collins, Colorado, USA.

Singla N. and M. Garg, 2013. Effect of crude cottonseed oil containing gossypol on fertility of male and estrous cycle of female *Bandicota bengalensis* Gray and Hardwicke," Journal of Applied Animal Research, vol. 41, no. 2, pp. 156–165.

Singla N. and V. R. Parshad 2007. Antifeeding effects of a neem (*Azadirachta indica*)-based formulation botanical bird repellent against the house rat (Rattus rattus),” Indian Journal of Agricultural Sciences, 77 (8), pp. 502–504.
Singla N., R.K. Thind and A.K. Mahal.2014. Potential of eucalyptus oil as repellent against house rat, Rattus rattus. The scientific world journal, Volume 2014, Article ID 249284.
Sood, M. L. and S.S. Guraya, 1976. Rats and Their Control. Punjab Agricultural University, Ludhiana: press Publication.
Sridhara, S. 1983. Rodenticide induced bait aversion and neophobia in Tatera indica cuviere. Zeitshrift Fur Angewandte Zoologic 10:429-440.
Tripathi P., N. K. Dubey and A.K. Shukla, 2008. Use of some essential oils as post-harvest botanical fungicides in the management of grey mould of grapes caused by *Botrytis cinerea*. World Journal of Microbiology and Biotechnology, 24 (1), pp. 39–46.
Wager-Page S. S., J. R. Mason, E. Aronov, and G. Epple 1995. The role of sensory cues and feeding context in the mediation of pine needle oils repellency in prairie voles,” in Proceedings of the National Wildlife Research Center Repellents Conference, Denver, Colo, USA, paper 38.

MODIFICATION AND EVALUATION OF INDIGENOUS TRAP FOR CONTROLLING FIELD RAT

A T M Hasanuzzaman and M S Alam

Abstract

The experiment was conducted in outdoor rat enclosure at vertebrate pest division and different experimental fields in BARI, Joydebpur, Gazipur during 2021-22 to evaluate the comparative efficacy of newly designed kill trap and commonly used live and kill trap. The efficacy of newly designed snap trap and commonly used live and snap trap were statistically similar in both enclosure and field-test. In enclosure test, the average success of newly designed snap trap and commonly used live trap was 40.00% and 32.00% respectively whereas commonly used kill trap showed only 28.00% success. In field, the average success of newly designed snap trap and live trap was 43.90% and 38.00% respectively whereas commonly used kill trap showed 28.05% success.

Introduction

People are very concern about rodent control. Several rodent pests cause serious damage to our agricultural crops in the field and in storage. Rodents consume and contaminate food with their fur, urine and feces. Their constant gnawing damages property. Rodent damages building, household’s good and electrical wire etc. They also are potential threats to both human and animal health through transmission of diseases (Wang, 1996).

The use of rodenticides, in the form of poison bait, is the most common means of rat control in Bangladesh. However, especially in rural areas there are several constraints to their use. Primarily, rodenticides are not affordable to the rural poor who are most affected by the rodent pests. Even when rodenticides are widely available, they are often used inappropriately, leading to low efficacy by developing bait shyness in rodent population. In some cases rodenticides created serious health hazards to human beings and their pet animals and created environment pollution. After continued use of poison baiting, rodents try to avoid bait, which are popularly known as bait-shyness. This shyness creates a serious problem in rodent control by developing a residual population. Changing control techniques with trapping can solve this problem. On the other hand, by constant and indiscriminate use of anticoagulant rodenticides, rodents can develop resistance on it (Buckle, 1999).

Recently, there has been an increased effort to apply our understanding of rodent population dynamics to develop more ecologically sound methods of rodent management. Non-chemical device - such as trapping rodents is an age old method for rodent population management. Some scientists have shown that trapping can, under some circumstances, be an effective method of rodent management (Gebauer, et al. 1992, Tobin et al. 1993, Ahmed et al. 1995). Two types of traps i.e., live trap and snap (kill) trap are commonly used for controlling rodents in Bangladesh. Farmers' often use some indigenous traps for controlling rodent and get considerable success. In this experiment we shall try to evaluate and modify some indigenous rat trap to increase its effectiveness for controlling rodents. The objective of the study was to develop highly effective eco-friendly device to control the rodent pest.

Materials and methods

One indigenous trap was collected from the farmers of Dinajpur region and this trap was modified in the lab of vertebrate pest division, BARI and then the efficacy of newly designed trap for capturing rodent was evaluated. The experiment was conducted at inside the rodent enclosure of vertebrate pest Division, BARI and research field of BARI, Joydebpur, Gazipur during November, 2021 to May 2022. Two types of test vis. enclosure test and field test was conducted for this experiment.

Enclosure test: This test was conducted inside the rat enclosure (6m X 4m) during Rabi 2021 -2022. Lesser bandicoot rat *Bandicota bengalensis* was used as test animal. The animals were kept under the laboratory condition for at least 3 weeks for acclimatization before starting the experiment. All animals were starved for 6 hours before applying the treatment. Five rats were released into the enclosure. Five newly designed snap traps and five local kill traps and five live trap were set inside the enclosure. Bread was used as bait material for all types of traps. Traps were randomly set inside the enclosure. All the traps were set in every evening and the data were recorded in the following morning. This test was conducted up to 5 days. Percent trap success for different traps were calculated.

Field test: Field test was conducted in different research field of BARI. For this experiment, up to seven active burrows were selected for each type of trap. The burrows with rat inside and having fresh soil at the opening including some symptoms of new activities were identified and marked as the "active burrows". The presence of rat inside the burrow was ensured by using tracking tiles. One trap was set near the active burrow openings of each burrow system. Bread was used as bait material for all types of trap. Traps were randomly set near the burrow opening. All the traps were set in every evening and the data were recorded in the following morning. This test was conducted up to 5 days. Per cent trap success for different traps were calculated.

Result and discussion

Enclosure test: The result of enclosure test was presented in figure 1. The per cent trap success of newly designed snap trap and commonly used live and kill traps were statistically similar ($F_{2,12} = 0.538, P = 0.597$). The newly designed snap trap and commonly used live trap showed 40% and 32% success for trapping rodents where commonly used kill trap showed only 28% success. The locally available kill traps used in this experiment, were very good quality traps but in this experiment sometimes this trap was found as sprung without capturing rodents due to it's over sensitivity which might have contributed to lower success of this trap.

Field test: In field test, all the three types of traps showed the similar performance for controlling rodents ($F_{2,12} = 2.714, P = 0.107$). The newly designed snap trap showed 43.90% success; on the other hand, commonly used live and snap trap showed 38.00% and 28.05% success respectively. In another experiment, Alam *et at.,* (2005) found that, kill trap showed 7.66 % success. Farmers of that area used kill trap in their poultry farm for controlling rodents. Though, newly designed snap trap did not perform significantly better result compared to the commonly used live and snap traps but it has some good effect like: - a) trap sensitivity is the main factor for setting trap to get good result but it is not a matter in case of newly designed trap, b) it can be set easily, c) trapped rat can be removed easily, d) comparatively safer than the local snap trap. There is a limitation of this trap i.e. the trigger rope of this trap has to be changed in every setting time. Considering all these things it can be conclude that farmers can use the new designed snap trap in crop field, godown, poultry farm, houses etc. Further evaluation is needed to confirm this result and this experiment should be continued to further improvement of the newly designed trap.

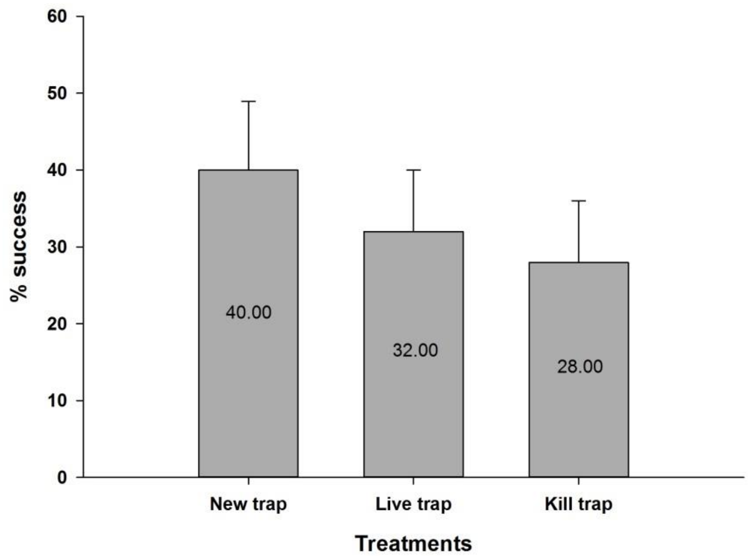

Fig 1. Comparative efficacies of newly designed snap trap and commonly used live and kill traps for trapping rodent in rat enclosure.

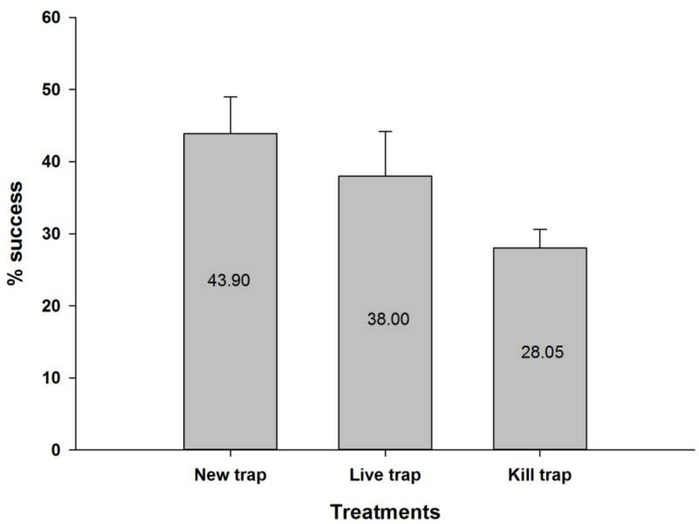

Fig 2. Comparative efficacies of newly designed snap trap and commonly used live and kill traps for trapping rodent in field.

References

Ahmed, E,I. Hussain and J.E. Brooks. 1995. Losses of stored foods due to rats at grain markets in Pakistan. International Biodeterioration and Biodegration. 36, 125-133.

Alam, M.S, M.Y. Mian, and A.T.M. Hasanuzzaman, 2005. Efficacy of different bait materials for trapping rodents. Annual Report 2004-2005, Vertebrate Pest Division. BARI. 6-11 p.

Buckle, A.P. 1999. Rodenticides-their role in rodent pest management in tropical agriculture. In: Singleton, G.R., Hinds, L.A., Leirs, H. and Zhang, Z., ed., Ecologically-based management of rodent pests. ACIAR Monograph No. 59, Canberra, Australian Centre for International Agricultural Research, 163-177.

Gebauer, U., V. Dubbel and E. Friedrich. 1992. Control of small rodent pests with spring traps. Allgemeine Forst Zeitschrift, 47, 408-409

Roy, L.G., R.K.T. Singh and K.D. Singh. 1987. Rodent control in Poultry farm near lmphal, Monipur, India, using Bromadiolne. Rodent Newsletter. 11 (1-4), 8.

Tobin, M.E., A.E. Koehler, R.T. Sugihara, G.R. Ueunten, and A.M. Yamaguchi, 1993. Effect of trapping on rat populations and subsequent damage and yield of macadamia nuts. Crop Protection. 12, 243-248

Wang, C.X. 1996. Rodent control and public health. In: Wang,Z.W. and Zhang, Z.B., ed., Theory practice of rodent pest management. Beijing, Science Press, 38-52 (in Chinese, with English abstract).

EVALUATION OF SOME WRAPPING MATERIALS FOR POISON BAITING INSIDE THE BURROW

A T M Hasanuzzaman and M S Alam

Abstract

The experiment was conducted in the experimental field of Bangladesh Agricultural Research Institute (BARI) in 2021-2022. Different wrapping materials i.e. butter paper, para film, tree leaf and writing paper were evaluated for poison baiting inside the wet burrow and rodent control success was recorded. Highest success was observed with writing paper (49.43%) wrapped poison baiting which was statistically similar with bamboo leaf (45.71%) and butter paper wrapping (31.50%). Lowest success was found in case of para film (29.71%) wrapped poison baiting.

Introduction:

Rodent pests cause serious damage to our agricultural crops and in stores. Rodents are serious pest to wheat crop throughout southern Asia causing a damage of 3.5-12% (Bindra and Sagar, 1968; Sood and Guraya, 1976; Poche et al., 1979; Ahmad *et al*, 1986). Rodents damage buildings, households goods and electrical wire etc. and they are also involved in the transmission of human diseases. According to Ahmed (1986) rat cause 5.7% losses to deep water rice. Rats are major problem in the poultry sector too. In Bangladesh, farmers commonly use zinc phosphide, aluminiun phosphide and lanirat (Bromadiolone) to control rodents. In developing countries, acute rodenticide, zinc phosphide in commonly used to control rodents. But it induces bait shyness making the bait less acceptable to rodents (Barnett and Prakash, 1975).

Others researchers have also reported bait acceptance problems related to bitter taste of zinc phosphide and /or sub-lethal illness and subsequent conditioned aversion after rodents ingest minimal level of bait (Sridhara 1983, Prakash and Ghosh 1992, Reidinger 1995).

In Bangladesh, farmers generally used zinc phosphide poison bait for controlling burrowing rodents. Inside burrow baiting where zinc phosphide poison bait wrapped with paper and placed inside burrow is an effective method for controlling burrowing rodent. In aman rice field, rat burrows remain water inside that wet the wrapping paper and damage the quality of poison bait. The experiment was planned to evaluate some wrapping material for poison baiting inside the wet burrow. The objective of the study was to find out the highly effective wrapping material for poison baiting inside the burrow so that rodent pest can be controlled successfully in aman rice.

Materials and Methods:

The experiment was conducted in research field of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. In this experiment, four wrapping materials viz. wax paper, parafilm, tree leaf (bamboo leaf) and paper were used for poison baiting inside the burrow where paper was used as a control treatment. Twenty five to thirty wet burrows that placed in the drain side were used for each treatment. Before applying treatments all the active burrows were identified properly. The burrows with rats inside and having fresh soil at the opening including some symptoms of new activities were identified and marked as the "active burrows". Only active burrows were used for applying the treatments. The pre and post-treatments rodent population index was taken by using tracking tiles. Two tiles (20 cm x 20 cm) were used for each treatment. Tile index were taken for two nights for both pre and post treatment operation. The activities of rat were determined on the basis of active tiles.

For applying the treatment, opening of active burrow was cleaned properly with a bamboo stick. About 1 gm of Zn_3P_2 poison bait (8-10 grains) wrapped with a treatment material and placed inside the burrow in one foot depth. Then the burrow opening was sealed with soil ball. After 24 hours, if no rodent activity was found at burrow opening, then the treatment was considered as a successful treatment. The result was verified with tracking tile index.

Result and discussion:

The results of different treatment were presented in figure 1. The rodent control success was varied significantly among the treatments ($F_{3,16} = 4.866, P<0.05$). Rodent control success of poison wrapped with butter paper, parafilm, bamboo leaf and paper was 31.50%, 29.71%, 45.71% and 49.43% respectively. The highest success of rat control was achieved with paper wrapped poison which was statistically similar with butter paper and bamboo leaf. Lowest success was achieved by parafilm wrapping poison baiting. In another experiment Hasanuzzaman and Mian (2005) found more than 80% success in rodent control using paper wrapped poison inside the burrow. In this experiment the success was not satisfactory because the burrows were in wet condition that damaged the paper as well as degraded the quality of poison bait. Besides, rat may be dislike wet bamboo leaf, butter paper and parafilm that can be the reason of lower success in rodent control when these materials were used for wrapping the poison. Further evaluation is needed to confirm this result and this experiment should be continued to find out the suitable wrapping material for poison baiting inside the burrow especially in wet condition.

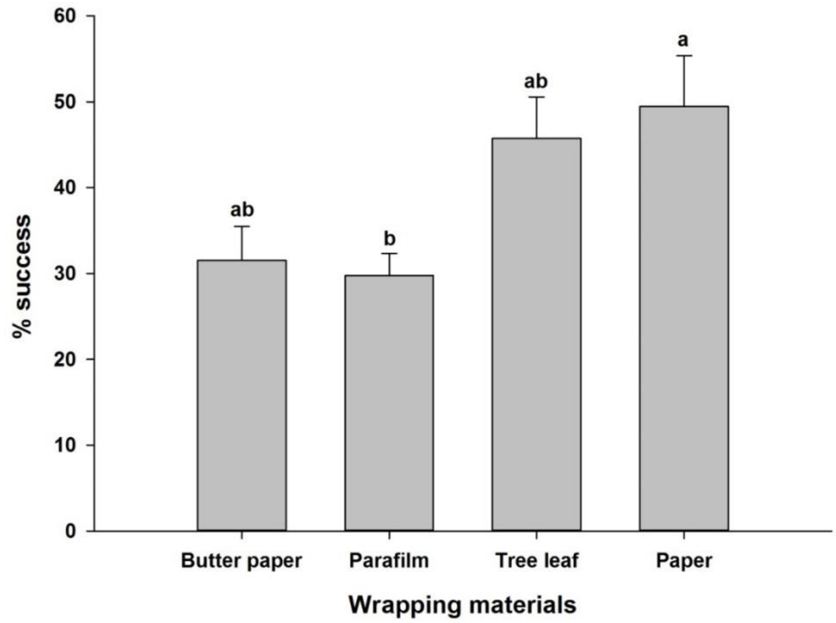

Fig 1. Comparative efficacies of different wrapping materials for effective poison baiting inside the burrow.

References:

Ahmad, N., 1986. Studies on rodent pest management in agro and forest ecosystems. Unpublished PhD thesis, Garhwal University,Srinagar.

Ahmed, M.S., Mian, M.Y, Haque, M. E & Brooks, J.E (1986). Estimating rat damage in deep water rice. Int. Rice Res. Newsl,. 11(1), 23-4.

Barnett, S. A. and I. Prakash., 1975. Rodents of economic importance in India, pp.1-175. New Delhi and London: Arnold-Heinemann.

Bindra, O. S. and P. SAGAR., 1968. Study on the losses to wheat, groundnut and sugarcane crops by the field rats in Punjab. Proceedings of the International Symposium on Bionomics and Control of Rodents, pp.28-31.Kanpur, India.

Hasanuzzaman A.T.M. and M. Y. Mian, 2005. Placement of zinc phosphide bait for controlling burrowing rodents. *Bangladesh j. entomol.* 15 (1), 85-87.

Poche, R.M., M.Y.Mian, M. E.Haque, D. Mian, A.I.Mannan, A.II. Mannan and Sultana, P.,1979. Rodent damage to wheat in Bangladesh. Special Report No. 1, Vertebrate Pest Division. Bangladesh Agricultural Research Institute.

Prakash, I, and P. Ghosh, editors. 1992. Rodents in Indian Agriculture, Vol., Scientific Publishers, Jodhpur, India.

Redinger, R. F. Jr. 1996. Recent studies on flavor aversion learning in wildlife damage management. Pages 10l -120 *in* J. R. Mason. editor. Repellents in Wildlife Management: Proceedings. Colorado State University: Fort Collins, Colorado, USA.

Sood, M. L. and S.S. Guraya, 1976. Rats and Their Control. Punjab Agricultural University, Ludhiana: press Publication.

Sridhara, S. 1983. Rodenticide induced bait aversion and neophobia in *Tatera indica cuviere.* Zeitshrift Fur Angewandte Zoologic 10:429-440.

SURVEY ON SQUIRREL DAMAGE IN DIFFERENT FRUITS AND VEGETABLES IN SELECTED AREAS OF BANGLADESH

Md. S. Alam and A.T.M. Hasanuzzaman

Abstract

A study was conducted among the farmers on squirrel problem in different crops in Cumilla districts of Bangladesh during 2021-22. All the upazilla of Cumilla district farmers reported two types of squirrels which were brown and striped whereas brown was pre dominant in Cumilla. According to the farmers' opinion, vegetables and fruit crops were frequently damaged by the squirrels. Most affected vegetable crops were bean (50%) followed by bottle gourd (40%) Ridge gourd (18.33%) and pumpkin (16.67%). Among the fruit crops maximum damage was found in coconut (44.16%), followed by Guava (46.7%) ber (28.3%), betelnut (29.16%) and and mango (22.5%). Farmers reported that average Tk. 500-1000 per family per year was lost in case of vegetables damaged by squirrel while it was more than Tk. 1000 in case of fruits. Maximum damage was occurred at full grown stage (51.67%) followed by all stage (26.67%) of the crop in all the season. Farmers were unknown about the breeding frequency, breeding season and number of young per parturition. Most popular control method used by the farmers was cage Trapping (46%) followed by snap trapping (29%) poison (12%).

Introduction

Squirrels belongs to the order Rodentia. Several species of squirrels have been reported to occur in Bangladesh. These are Brown squirrel (*Callos ciurus phygery thrus*), five striped plum squirrel *(Funumbulus pennanti),* three striped plam squirrel, *(F. palmarum)* and malayan giant Squirrel, *(Rolufa bicolor)* (Khan, 1987). Brown squirrels are generally found in the districts of Dhaka and Chottogram division. Five stripped and three stripped squirrels are found in north west and south western districts of Bangladesh. Malayan giant squirrel is reported to occur in evergreen forests of Sylhet and Chottogram hill-tracts. Another group of squirrels are also found in Bangladesh. They are called flying squirrels. They are arboreal species and live mostly on trees in the forest but now also have adapted to human environments. They do not actually fly, they simply glide. They have developed a broad parachute like flap of skin which extends on either side of the body between the limbs and that enables them to glide through the air for a considerable distance. They are reported to inhabit in the forests of Chottogram. They are diurnal animals. So, they are usually seen during day time. All these species especially first three species cause damage to our fruits and vegetables crops. But intensity of damage and status of squirrel as an agricultural pest is yet unknown. This experiment was planned to understand the status of squirrel as a pest, their damage severity, to gain some basic knowledge about their habitat, control measures taken by farmers and the crop losses due to squirrel infestation through a questionnaire survey among the farmers in different districts of Bangladesh.

Materials and methods

The study was conducted in the squirrel infested area of Cumilla district during 2021-22. Four Upzilla of Cumilla district namely Chandina, Barura, Burichang and Debidwar were selected for this study. The questionnaire survey was conducted in four villages from each upazilla of Cumilla district. Questionnaire survey on squirrel damage in fruit and vegetables was conducted amongst fruit and vegetables growing farmers. The study was conducted among randomly selected 30 farmers from each upazilla of Cumilla district. Scientists of Vertebrate Pest Division took the framers interview with a prescribed questionnaire sheet. It included different questions such as on species composition, crops damaged by the squirrels, intensity of damage, amount of loss, breeding season, number of parturitions per year, control method used by the farmers etc. The farmers who actually worked in the farms during these seasons were selected for the questionnaire. It is also an important tool for understanding the extent of awareness about squirrel as part of the agro eco-system. Learning the traditional and modern techniques used by farmers and workers will surely be great experience in order to avoid the loss and their effectiveness. All questionnaire sheets were carefully filled up, compiled, summarized and presented in tabular form. Direct visual observation of squirrel damage was done in the farmers' fields/houses.

Results and Discussion

Types of squirrels

Different species of squirrel caused damage in different fruits, vegetables and grain crops. All the species were not available in all the location. Squirrel problems in fruits and vegetables were severe and most of the farmer opined that squirrel is serious problem. All most all the farmers (100%) opined that squirrel is the most serious pest in vegetables and fruits. In this study, farmers were asked about how many kinds of squirrel they had seen in their locality, The farmers reported two types of squirrels were seen in four upazilla of Cumilla and it were striped and brown types squirrel. brown squirrel was dominant (61.67% farmer reported) at Barura, Burichang and Debidwar upazilla of Cumilla district and brown squirrel locally also known as Irrawaddy squirrel. Stripe squirrel was dominant at Chandina upazilla of Cumilla district reportred by 60% farmers (Table 1).

Affected crops and economic loss

Squirrels usually damage fruits and vegetables crops. According to farmers' opinion, maximum vegetable crops were attacked by squirrel in Bean (50%), followed by bottle gourd (40%), Ridge gourd (18.3%), pumpkin (16.67%), all upazillas of Cumilla district (Table 2). Among the fruit crops, maximum damage was found in coconut (44.2%) followed by Guava (43.3%), Ber (28.3%), betelnut (29.2%), hogplum (25%) mango (22.5%), etc., are affected by squirrel at four upazilla of Cumilla a (Table 3).

Crop stage & Damage period

Fifty one percent farmers of Cumilla opined that squirrel caused damage at full grown stages of crop whereas 26.67% farmers opined all stages crop followed by ripening stage of crop (21.67%) at four upazilla of Cumilla district (Table 4). Farmers reported that during the day maximum squirrel activity was observed at morning (68.3%) and afternoon (85%) followed by morning and noon (16.67% at all four upazilla of Cumilla district (Table 5).

Squirrel beneficial role or aesthetic value and their seasonal activities

Farmers were asked about the beneficial role of squirrel. Ninety five percent farmers of Cumilla district reported that they have no beneficial effect at all and 5% farmers said they have beneficial role at Chandina upazilla of Cumilla district. About 61.67% farmers opined that squirrel activity was observed at summer season followed by winter (29.16%) and rainy season (20%) at all upazilla of Cumilla district. (Table 6).

Intensity of squirrel activity

To understand the depth of the problem, farmers were asked whether they have seen squirrel or squirrel damage symptom during last one week or one month. About 63% farmers had seen 5-10 squirrels, 33.33% had seen 10-20 squirrels during last one week whereas 73.3% farmers observed 20-30 squirrels, 20% farmers observed 30-40 squirrels and 6.67% farmers had not seen any squirrel during last one month at Cumilla district (Table 7). These indicate that squirrel problem was severe in the study areas.

Reproduction

Farmers were asked about the breeding habit of squirrel. According to the farmers' opinion, 100% farmers of all four upazillas Cumilla district did not know the breeding habitat and breeding procedure of squirrels (Table 8). About 100% farmers had no knowledge or unknown about breeding frequency per year and the breeding season of squirrel at Cumilla district. They also opined that breeding frequencies depend on the availability of food (Table 9).

To guess the economic impact and loss caused by squirrel in Cumilla district, farmers were also asked how much losses caused by squirrel during last one year. According to the farmers' opinion about average fruits losses (%), 50% reported 40-50% fruit and 43.33% farmers reported 60-70% fruit lost per year by squirrel whereas 100% opined 3000-5000 taka lost and 20% farmers reported 300-500 taka lost by squirrel damage at all upazilla of Cumilla district (Table 10). In case of vegetables, 65% and 25% farmers reported 20-40% and 40-50% vegetables were lost by squirrel by number. On the other hand 58% farmers opined 500-1000 Taka loss per year and 30% farmers reported 300-500 taka vegetables lost whereas 12.5% farmers opined about more than 1000 Taka vegetables loss per year per family caused by squirrel (Table 11) at four upazillas of Cumilla district respectively.

Squirrel control Technique

Farmers were asked about the control techniques they applied against squirrel. All the farmers (100%) opined that action needed to take against squirrel at Cumilla district. Eighty-two percent farmers of Cumilla district took action against squirrel and 18% did not take any action. Farmers reported, they used several control techniques against squirrel. Such as use of trap, shooting, use of poison bait and other type of control measures such as beating by stick, use of catapul gulti, and netting. Among these, 46.6% farmers used cage trapping, 29.16% used snap trapping, 3% used repelling squirrel and 12.5% farmers used poison bait. About 2% of them were not satisfied about the traditional control techniques of squirrel and 51.67% opined these control techniques were good, 46.67% farmers were satisfied using these techniques to control the squirrels (Table 12).

Conclusion

This experiment is part of a nation-wide survey on squirrel damage in different crops. In this experiment only four upazillas of Cumilla districts were covered. The results showed that in economic point of view, the crop losses by squirrels are not negligible. So other areas of the country should be surveyed later on.

Table 1. Types of squirrels in crop fields in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)							
	squirrel problem		Type and colour of squirrel species observed in study area					
	Yes	No	Type			Colour		
			1	2	3	Striped	Brown	Both
Chandina	30 (100)	-	26 (86.67)	4 (13.33)	-	18(60)	8 (26.67)	4(13.33)
Barura	30 (100)	-	30 (100)	-	-		30(100)	
Burichang	30 (100)	-	20 (66.67)	10 (33.33)		10 (33.33)	16	4
Debidwar	30 (100)	-	22 (73.33)	8 (26.67)		10 (33.33)	20	-
Average (n= 30)	30 (100)	-	25.63 (85.41)	5.5 (18.33)		9.50 (31.67)	18.5 (61.67)	2 (6.67)

n= Number of respondent (farmers)

Table 2. Vegetable crops damaged by squirrels in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)				
	Bean	Pumpkin	Bottle gourd	Ridge gourd	Cucumber
Chandina	15 (50.0)	5 (16.67)	15 (50.0)	4 (13.3)	5 (16.67)
Barura	15 (50)	15 (50.0)	-	13 (43.33)	5 (16,67)
Burichang	15 (50.0)	-	16 (53.33)	5 (16,67)	
Debidwar	15 (50.0)	-	17 (56.66)	-	8 (26.67)
Average (n= 30)	15 (50.0)	5 (16.67)	12 (40.0)	5.5 (18.33)	4.5 (15.0)

Table 3. Fruit’s crop damaged by squirrels in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)										
	Coco nut	Jack-fruit	Guav a	Mango	Ber	Betel nut	Banana	Papay a	Pumell o	Hogpl um	Carambol a
Chandina	12 (40.0)	-	16 (53.3)	11 (36.7)	13 (43.3)	3 (10)	8 (26.7)	3 (10)	2 (6.7)	5 (16.6 7)	-
Barura	14 (46.6)	7 (23.3)	12 (40)	9 (30)	7 (23.3)	10 (33.3)	7 (23.3)	4 (13.3	6 (20)	8 (26.6)	
Burichang	15 (50.0)	4 (13.3)	16 (53.3)			10 (33.3)	8 (26.66)			10 (33.3)	4 (13.3
Debidwar	12 (40.0)	3 (10)	8 (26.6)	7 (23.3)	14 (46.6)	12 (40.0	7 (23.3)	3 (10)		7 (23.3)	5 (16.66)
Average (n= 30)	13.25 (44.2)	3.5 (11.6)	13 (43.3)	6.75 (22.5)	8.5 (28.3)	8.75 (29.2)	7.5 (25)	2.5 (8.3)	2 (6.7)	7.5 (25)	3.5 (11.6)

Table 4. Crop stage affected by squirrels in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)			
	Immature	Full grown	Ripening stage	All stages
Chandina		16 (53.33)		14 (46.6)
Barura		18 (60)		12 (40)
Burichang		10 (33.3)	20 (66.67)	-
Debidwar		18 (60.0)	6 (20.0)	6 (20.0)
Average (n= 30)		15.5 (51.67)	6.5 (21.67)	8 (26.67)

Table 5. Time of squirrel activity during day and night in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)				
	Day	Night	Day time when		
			Morning	Noon	Afternoon
Chandina	30 (100)	0	30 (100)	-	30 (100)
Barura	24 (80)	6 (20.0)	30 (100)	-	30 (100)
Burichang	30 (100)	0	10 (33.3)		20 (66.67)
Debidwar	12 (40.0)	18 (60.0)	12 (40.0)		22 (73.33)
Average (n= 30)	24 (80.0)	6 (20)	20.5 (68.33)		25.5 (85.0)

Table 6. Beneficial role or aesthetic value of squirrel and seasonal activities of squirrels in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)					
	Beneficial or not		Seasonal of Activity			
	No	Yes	Summer	Rainy	Winter	All time
		Beauty of nature				
Chandina	26 (86.67)	4 (13.33)	20 (66.67)	6 (20)	2 (6.67)	2 (6.67)
Barura	28 (93.33)	2 (6.67)	17 (56.67)	6 (20)	7 (13.33)	0
Burichang	30 (100)		16 (53.3)	-	14 (46.6)	
Debidwar	30 (100)		12 (40.0)	-	2 (6.67)	
Average (n= 30)	28.5 (95.0)	1.5 (5.0)	18.5 (61.67)	6 (20)	8.75 (29.16)	2 (6.67)

Table 7. Squirrel seen during last one week and one month in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)									
	During last one week					During last one month				
	Yes				No	Yes				No
	5-10	10-20	30-40	>40		20-30	30-40			
Chandina	18 (60)	8 (26.6)			4 (13.33)	20 (66.67)	4 (13.3)			6 (20.0)
Barura	22 (73.33)	8 (26.67)			-	24 (80.0)	6 (20.0)			
Burichang	24 (80.0)	6 (20.0)			-	24 (80.0)	4 (13.3)			2 (6.67)
Debidwar	12 (40.0)	18 (60.0)				20 (66.67)	10 (33.33)			-
Average (n= 30)	19 (63.3)	10 (33.33)			1 (3.3)	22 (73.3)	6 (20.0)			2 (6.67)

Table 8. Breeding habitat and number of young squirrels per parturition of squirrels in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)							
	Breeding habit				No. of youngs/per partuation			
	Un-Known	Tree hole			Un-known	2-3	3-4	5-6
Chandina	30 (100)				30 (100)			
Barura	30 (100)				30 (100)			
Burichang								
Debidwar								
Average (n= 30)	30 (100)				30 (100)			

Table 9. Breeding frequency & breeding season of squirrel in in the study area of Cumilla districts during 2021-22.

Place	Number of respondent (%)										
	Breeding frequency per year					Breeding season i.e month					
	Un-known	1	2	3	4	Un-known	Year round	April - May	June-July	Octo-Dec	Jan-March
Chandina	30 (100)					30 (100)				-	-
Barura	20 (66.67)					30 (100)					
Burichang	30 (100)					30 (100)					
Debidwar	30 (100)					30 (100)					
Average (n= 30)	30 (100)					30 (100)					-

Table 10. Fruit loss caused by Squirrel in the study area of Cumilla districts during 2021-22.

Places	Number of respondent (%)					
	Loss (%)			Loss in Taka		
	40-50	60-70	80-100	300-500	500-1000	3000-5000
Chandina	14 (46.67)	16 (53.33)				30 (100)
Barura	12 (40.0)	10 (33.33)	8 (26.67)			30 (100)
Burichang	10 (33.3)	20 (66.67)				30 (100)
Debidwar	24 (80.0)	6 (20.0)		25 (83.3)	5 (16.67)	
Average (n= 30)	15 (50.0)	13 (43.33)	2 (6.67)	6.25 (20.3)	1.25 (4.16)	30 (100)

Table 11. Vegetable loss caused by Squirrel in the study area of Cumilla districts during 2021-22.

Places	Number of respondent (%)					
	Loss (%)			Loss in Taka		
	20-40	40-50	60-70	300-500	500-1000	>1000
Chandina	25 (83.3)	5 (16.67)			26 (86.67)	5 (16.67)
Barura	12 (40.0)	18 (60.0)		8 (26.67)	12 (40)	10 (33.33)
Burichang	26 (86.67)	4 (13.33)		4 (13.3)	26 (86.67)	
Debidwar	27 (90.0)	3 (10.0)		24 (80.0)	6 (20.0)	
Average (n= 30)	19.5 (65.0)	7.5 (25.0)		9 (30.0)	17.5 (58.33)	3.75 (12.5)

Table 12. Control measure taken by the farmers in the study area of Cumilla districts during 2021-22.

Places	Number of respondent (%)											
	Action taken Needed		Control techniques use by farmers (%)						Control efficacy			
	Yes	No	Cage Trapping	Snap Trapping	Repel (Net)	Repel (Tin)	Poison	No action	Very good	Good	as usual	not satisfactory
Chandina	24 (80.0)	6 (20.0)	18 (60.0)	12 (20.0)	0	0		6 (20.0)		12 (20.0)	18 (60.0)	
Barura	30 (100)	0	8 (26.67)	3 (10.0)		4 (13.3)	15 (50.0)			4 (13.3)	24 (80.0)	2 (6.67)
Burichang	25 (83.33)	5 (16.6)	20 (66.67)	10 (33.33)						20 (66.67)	10 (33.3)	
Debidwar	20	10 (33.3)	10 (33.3)	10 (33.3)						26 (86.67)	4 (13.3)	
Average (n= 30)	24.75 (82.5)	5.25 (17.5)	14 (46.6)	8.75 (29.16)		1 (3.3)	3.75 (12.5)	1.5 (5.0)		15.5 (51.6)	14 (46.6)	0.5 (1.6)

References

Khan, M.A.R. 1987.Bangladesh Banyaprani (Wild life of Bangladesh) 3rd. Vol. Bangla Academy, Dhaka, p136.

BIRD DAMAGE AND BIRD SPECIES DIVERSITY IN SUNFLOWER FIELD

M. S. Alam, ATM Hasanuzzaman and K N. Islam

Abstract

The experiment was conducted at BARI central research field, Gazipur and farmers field of Amtoli, Barguna during rabi season in 2021-22 to find out the efficacy of different combination of repellent on sunflower against pest birds. Four treatments viz., Multicolour reflective ribbon, Plastic bottle wind mill, four side netting, and Untreated control (without repellent) were used in this experiment. The experiment was laid out in RCB design with four replications. From this experiment, it was revealed that significantly maximum damage of sunflower caused by the pest birds were in the control plots compared to netting treated plots. In control plots maximum 54.5% head damage and 62.5% plant damage were happened by the birds whereas The lowest head and plant damage were recorded in plastic bottle windmill (17%) and four side treated plot (25%) respectively in Gazipur. The lowest head and plant damage were recorded in plastic bottle windmill 14.33% and 30% respectively, the highest was recorded in control plot (24.33 and 46.67% respectively) at Amtoli, Barguna. Yield was also recorded higher in plastic bottle windmill treated plot (2.0 t/ha) compared to other treatments. Fourteen birds species were recorded in sunflower belonging to 14 families and 6 orders during the study periods from dawn to dusk. Passeroformes was the most dominant order (57%) represented 6 families and species followed by order Collumbiformes (2 families 2 species). However, the species richness and Diversity of bird species were obtained higher in morning (14) and noon (9) than afternoon (7).

Introduction

Sunflower (*Helianthus annuus* L.) is a globally important oilseed and a high-value crop. It is very susceptible to birds. Birds cause economic losses in a variety of crops like wheat, maize, sun flower, groundnut and citrus etc. It is stated that crows and parakeet are very destructive to sunflower. So susceptible, in fact, that bird damage can lead to the entire crop being destroyed and abandoned. Bird damage to sunflower is recognized as an international economic problem for sunflower producers. Bird attacks on sunflower crops occur from the sowing stage. Sometimes they occur later - in almost cases - affecting the flower head. Attacks can be very frequent and cause substantial damage to the sunflower crop.

Regional surveys of bird damage to sunflowers conducted outside the United States are practically nonexistent, but localized damage of up to 25% of a field has been reported in various countries (Linz and Hanzel 1997, Khaleghizadeh 2011). In South America, members of the parakeet (Psittacidae) and dove (Columbidae) families can form roosts numbering in the millions and cause significant damage to nearby sunflowers (Bucher 1992, Rodgriguez et al. 1995). In Australia, cockatoos (Cacatuidae) and parrots (Psittacidae) are the main culprits (Bomford 1992). Sparrows (Emberizidae, Passeridae), doves, and crows (Corvidae) cause most of the damage in Europe, whereas parakeets and parrots do so on the Indian subcontinent (De Grazio 1989). However, in order to limit the damage caused by these birds, measures have to be taken to protect the sunflower crop from its inception. Trapping, netting and scaring is common means of bird control techniques in maize and sunflower field where, scaring of bird with reflecting ribbon is considered as an effective and eco-friendly bird control option. Different repellents options may reduce the attacking of bird pests which may help in crop production.

Bird survey is the best method to understand the different species distribution, abundance and diversity of wild bird in a specific area or a crop land (Issa, 2019). About 816 bird's species occurred in Bangladesh of which 388 are resident, and the rest are migratory (Lepage, 2021; Anonymous, 2012). Population density and species diversity of birds is differing, increasing or decreasing according to habitat type and richness. The avian diversity in agricultural landscapes has been studied by different authors in different states of India. Work has been done on bird composition and diversity in the agricultural fields, Agronomy field, Paddy fields of different part of India (Abdar 2014; Hossain &

Aditya 2016; Elsen et al. 2016, Mukhopadhyay & Mazumdar 2017, Narayana et al. 2019; Kumar & Sahu 2020; Jayasimhan & Pramod 2019; Sundar & Kittur, 2013).

However, in Bangladesh there is no systematic and detailed research work has yet been done for protecting birds using netting and repelling pest bird and bird species diversity in sunflower field. In this context, the present study is designed to document the bird species composition and diversity in sunflower field and also planned for protecting sunflower from pest birds using repelling techniques and nylon netting.

Materials and Methods

The experiment was conducted at BARI central research field, Gazipur and farmers field of Amtoli, Barguna during robi season of 2021-22. In this study different type of repelling techniques and netting were used as mechanical repellent against bird pests. Four treatments were used viz. T_1 = Multicoloured reflecting ribbon, T_2 = Plastic bottle windmill, T_3 = Four side netting, T_4 = Untreated control (without netting). The experiment was laid out in RCB design with four replications. BARI Surjomukhi-3 was used as test crop. The unit plot size was 5 X 4 meter. Seeds were sown on 26 December 2021, 50 cm x 25 cm spacing was maintained. In Barguna the unit plot size was 10 decimal. BARI Surjomukhi-2 was used as test crop. Seeds were sown on 10-26 January 2022 which 50 cm x 25 cm spacing was maintained. The plot was fertilized with 180-150-120-120-10 kg ha^{-1} in the form of Urea, TSP, MoP, Gypsum, Boric acid, respectively in the field. Half of Urea and full doses of all other fertilizers were applied at final land preparation. The rest Urea was applied in two equal split at 25 DAS and 45 DAS in the growing season. All intercultural operations were done in proper time for better growth of the crop. Nylon Nettings were tied up over the crops longitudinally and were supported by Bamboo stick and plastic rope. The nylon nets were tie up at the milking stage of the crop. Height of the netting were given special consideration because too high and too low reflectors had no significant effect on visiting bird pests.

Table.1 The detailed of treatments and installation process

Treatments	Making required materials	Cost of preparing each device (Tk.)	Total cost/ha (Tk.)	Installation process
Multicolour reflecting ribbon	Multicolour (Red/Blue/Pink/Green) ribbon, thin plastic rope etc.	Approximate Tk. 250 was spent on each 10 decimal of land.	6250	After maintaining the thin plastic rope at a distance of 5m, 2 feet long ribbon was cut and tied at 2 feet intervals to the thin plastic rope.
Plastic bottle windmill (Note: Tk. 15 for cost of preparing each device)	Plastic bottle, red sticky tape, thin stiff stick etc.	Approximate Tk. 300 was spent on each 10 decimal of land.	7500	Each device was maintained at a distance of 5m x 5m which would require approximate 500 devices per hectare of land.
Four side nylon netting	Nylon net, thick plastic rope, stiff bamboo etc.	Approximate Tk. 350 was spent on each 10 decimal of land.	8750	After placing a thick plastic rope over the crop at a distance of 5 m, then the net was spread.

The netting erected about one foot above the crop was found to give better results. Number of healthy sunflowers, number of damaged flowers, and percentage of damaged flowers caused by pest birds were recorded. The number and types of birds were also recorded. Bird survey data were attained using the point count and direct observations methods which is count from a fixed location for a fixed time period at flowering to maturity of the sunflower crop. This method is suitable for studying highly visible and/or local bird species in a wide variety of habitation. In this study birds were counted from a fixed raising point within a circle of 60 meter distances for a specific period of time (12 hours) every day. After 5

minutes settling period all birds seen and heard within 60 m distance were recorded during the 12 hours periods. Bird counts were started early in the morning from 6 am to 6 pm. Bird counts were divided into three recorded time of the days viz., Morning (6 am 11 am), Noon (11 am – 2 pm) and Afternoon (2 pm to 6 pm). Windy and rainy condition during the day of the study were avoided. A Digital camera and attention were done to confirm species identity. Proofs of identifications were done using Collins Birds Guide (Svensson et al., 2009). Species were assigned to families and order (Lepage, 2021: Clements et al 2019).
The data was analyzed by SPSS verson 26 software and presented as table form. Descriptive statistics (mean and SE) were used to illustrated different Treatment's. To assess and compare the diversity of birds species visited in sunflower field in morning, noon and afternoon by using Margalef species richness (d), Shannon's-Weiner Diversity index (H), Peilou's evenness (E) indices and Simson dominance index (C) (Magurran, 1988; Ferdous et al, 2015; Ulfah et al, 2019).

Margalef species richness (d)

$$d = \frac{(S-1)}{\text{Log (N)}}$$

Where,
S = Total species,
N = Total individuals
Higher the index greater the richness

Shannon-Weiner Diversity Index (H)

Diversity index (H) states the circumstances of the organism's population mathematically to analyze the number of individuals in each growth step or genus in a habitat community. The most commonly used diversity index is the Shannon-Weiner index (Odum, 1971)

$$H = -\sum(Pi \times \ln Pi)$$

Where H = Shannon-Weiner index, $Pi = \frac{ni}{N}$
ni = Number of individuals of a species, N =Total individuals of all species
The diversity index criteria are as follows:'

$H \leq 1$ = Low diversity
$1 < H \leq 3$ = Moderate diversity
$H \geq 3$ = high diversity

Simpson's Index of Diversity (D)

$$D = 1 - D'$$

$$D' = \frac{\sum n(n-1)}{N(N-1)}$$

n = Number of individuals of a species, N =Total individuals of all species
The value of this index also ranges between 0 and 1, but now, the greater the value, the greater the sample diversity.

Evenness Index

The evenness index (E) describes the number of individuals between species in a fish community. The more evenly distributed individuals between species, the more balanced the ecosystem will be. The formula used is (Odum, 1971):

$$J = \frac{H}{\text{Hmax}}$$

Where E = Evenness index, H = Diversity index, H_{max} = ln S, S = Number of species found
The evenness index value ranges from 0-1. Furthermore, the evenness index based on Kreb, 1989 is categorized as follows:

$0 < E \leq 0.5$ = Depressed community
$0.5 < E \leq 0.75$ = Unstable community
$0.75 < E \leq 1$ = Stable community

The smaller the evenness index, the population uniformity smaller as well. It shows the distribution of the number of individuals of each species is not similar so there is a tendency for one species to dominate. The greater the uniformity value describes the number of biotas in each species the same or not much different.

Simpson dominance Index (C)
An uniformity index and small diversity indicates a high dominance of a species against other species. The dominance index formula as follows (Odum, 1971):

$$C = \sum_{i=1}^{s} \left(\frac{\mathrm{ni}}{\mathrm{N}}\right)^2$$

Where C= Dominance Index, Where,
ni = number of individuals in the 'each' species,
N = total number of individuals, S = total number of species,
Index values range from 0 - 1 by the following categories:
$0 < C < 0.5$ = Low Dominance.
$0.5 < C \leq 0.75$ = Moderate Dominance.
$0.75 < C \leq 1.0$ = High Dominance.

Results and Discussion

Effect of netting on bird damage in sunflower differed significantly among the treatment in Gazipur. The highest percentage of head and plant damage were recorded in control treatment 54.5% and 62.5% respectively where no repellent techniques was set compared with all other treatments. The lowest head and plant damage were recorded in plastic bottle windmill (17%) and four side treated plot (25%) respectively (Table 2). There were no significant differences among all the repellent techniques. The highest yield kg/plot and t/ha was found in the treatment where the plastic bottle windmill was used (2.18 kg/plot and 1.09 t/ha respectively) and lowest in control plot (0.66 kg/plot and 0.33 t/ha respectively) (Table 2).

Percentage of head and plant damage were recorded in control treatment 24.33% and 46.67% respectively where no repellent techniques was set compared with all other treatments at Amtoli, Barguna. The lowest head was recorded in plastic bottle windmill (14.33%) and four side treated plot (16.67%) and lowest plant damage was recorded in plastic bottle windmill (30%) and Multicoloured reflective ribbon (30%) (Table 3). There were no significant differences among all the repellent techniques. The highest yield was found in the plastic bottle windmill (2.00 t/ha), followed by Multicoloured reflective ribbon (1.92 t/ha) and lowest in control plot (1.69 t/ha)

Table 2. Effect of different repellent techniques against bird damage and yield of sunflower during 2021-22 at BARI central research farm, Gazipir.

Treatments	% of Head damage	% head damage reduction over control	% of plant damage	% plant damage reduction over control	Yield Kg/plot	Yield t/ha
T_1= Multicoloured reflective ribbon	18.75 ± 4.2 a	65.59	30.0 ± 4.08 b	52.0	1.79±0.03ab	0.90±0.19 ab
T_2 = Plastic bottle windmill	17.00 ± 3.6 a	68.80	27.5. ±6.29 b	56.0	2.18±0.11 a	1.09±0.59 a
T_3 = Four side netting	29.5 ± 5.3 ab	45.87	25.0 ± 6.45 b	62.10	2.01±0.03 ab	1.0 ±0.15 ab
T_4= Untreated control	54.5 ±9.1 b	-	62.5 ± 6.29 a	-	0.66±0.05 b	0.33±0.27 b

Values in a column having same letter did not differ significantly (p=0.05)

Table 3. Effect of different repellent techniques against bird damage and yield of sunflower during 2021-22 at amtoli, Barguna farmers field.

Treatments	% of Head damage	% head damage reduction over control	% of plant damage	% plant damage reduction over control	Yield t/ha
T_1= Multicoloured reflective ribbon	18..0 ± 1.7	26.01	30.0 ± 5.7	35.71	1.92±0.02 a
T_2 = Plastic bottle windmill	14.33± 2.3	41.10	30.0 ± 5.7	35.71	2.00±0.01 a
T_3 = Four side netting	16.67 ± 2.4	31.48	36.67 ± 3.3	21.42	1.98±0.01 a
T_4= Untreated control	24.33 ± 2.3	-	46.67 ± 3.73	-	1.69 ±0.05 b

Values in a column having same letter did not differ significantly (p=0.05)

The structure of Birds populations visited sunflower field at BARI research field, Gazipur was differed. The acquired data demonstrated that the total number of wild bird species obtained was 14 species belonging to 12 families and 6 orders during the study periods. Passeroformes was the most dominant order (57%) represented 7 families and species (Table 4) followed by order Collumbiformes (2 family 2 species). While the lowest order in numbers were Coraciiformes, Psittaciformes, Cuculiformes, Accipitriformes and Pelecaniformes, which is illustrated by one species for each. The birds species richness value was highest in the morning (14) and noon (9), whereas this was lowest at afternoon (7) in a days at sunflower field (Table 5). Passeriformes order was the dominant species in our study, this result was also supported by another studies (Hussain and Adity, 2016; Yashmita-Ulman and Singh, 2021; Mahatu et al., 2021; Kumar and Sahu, 2019 and Issa, 2019). A study of avifauna survey maximum birds species were found in agricultural field (51.82%) followed by aquatic system (29.20%) and association with human habitation (18.98%) (Kumar and Sahu, 2020; Hussain and Adity, 2014). The number of different birds visited during flowering and fruiting stage of sunflower was recorded. Bird species richness were higher in the morning (14) and afternoon (9) compared to noon (7), This is probably due to weather condition. The sunshine and temperature were higher at noon compared to morning and afternoon. Our observation revealed that more bird species visited the sunflower in the morning and noon compared to afternoon.

Table 4. Wild birds species documented from sunflower field at BARI research farm during rabi 2021-22.

English name	Species	Family	Order	pest/visitor
Common Myna	*Acridotheres tristis*	Sturnidae	Passeriformes	Pest
Peid Myna	*Gracupica contra*	Sturnidae	Passeriformes	Pest
House sparrow	*Passer domesticus*	Passeridae	Passeriformes	Pest
Black drongo	*Dicrurus macrocercus*	Dicruridae	Passeriformes	Visitor
Red-vented bulbul	*Pycnonotus cafer*	Pycnonotidae	Passeriformes	Visitor
Oriental magpie-robin	*Copsychus saularis*	Muscicapidae	Passeriformes	Visitor
Common tailorbird	*Orthotomus sutorius*	Cisticolidae	Passeriformes	Visitor
Jungle crow	*Corvus macrorhynchos*	Corvidae	Passeriformes	Pest
Rose-ringed parakeet	*Psittacula krameri*	Psittaculidae	Psittaciformes	Pest
Common Kingfisher	*Alcedo atthis*	Alcedinidae	Coraciiformes	Visitor
Black Kite	*Milvus migrans*	Accipitridae	Accipitriformes	Visitor
Pond Heron	*Ardeola grayii*	Ardeidae	Pelecaniformes	Visitor
Spotted Dove	*Streptopelia chinensis*	Columbidae	Columbiformes	Pest
Rock Pigeon	*Columba livia*	Columbidae	Columbiformes	Pest

Table 5. Wild birds species documented from sunflower field at three parts of the days from BARI research farm during rabi 2021-22.

Morning (6 am – 11 am)	Noon (11 am – 2 pm	Afternoon (2 pm – 6 pm)
Common Myna Peid Myna House sparrow Black drongo Red-vented bulbul Oriental magpie-robin Common tailorbird Jungle crow Rose-ringed parakeet Common Kingfisher Black Kite Pond Heron Spotted Dove Rock Pigeon	Common Myna Pied Myna House sparrow Black drongo Red-vented bulbul Oriental magpie-robin Rose-ring arakeet Spotted Dove Black kite	Common Myna House sparrow Black drongo Red-vented bulbul Spotted Dove Rose-ringed parakeet Oriental magpie-robin
Birds species = 14 (2138)	Birds species = 9 (908)	Birds species = 7 (733)

Bird species diversity

The number of species and abundance of each species that live in a specific location is termed as species diversity. A diversity index is a numerical measure of how many different species are in a community (species richness) and how individuals are distributed within those species (species abundant) (You et al, 2009; Issa, 2019). Therefore, Diversity Index is considered as a calculation of variety, which is a useful tool to understand the profile of biodiversity across study area (Bibi & Ali, 2013). The species richness, diversity, evenness and dominance index and shown in Table 3.

In sunflower field in the Morning showed the highest values of diversity index, the total number of birds species were (2138) individuals, Margalef species richness index (d = 4.93), Shannon-Weiner diversity index (H′ = 1.86), and Simpson's Diversity index (= 0.81), while at afternoon displayed the lowest value of index, the total number were (733) individuals, species richness index (d = 3.08), Shannon-Weiner diversity index (H′ = 1.26), and Simpson's Diversity (D = 0.64). In contrast, evenness index (J′) were higher in noon (J′ = 0.59) than in morning (J′ = 0.19) and afternoon (J′ = 0.40) (Table 6).

These results were in link with Issa (2019). They mentioned that the avian diversity is an indication of habitat heterogeneity and the number of species and individuals in an area implies the importance of the area. Each habitat has a specific set of micro environments that is suitable for a species. Bibi and Ali (2013) cleared that the values of Shannon-Weiner Diversity Index usually fall between 1.5 and 3.5, only rarely it surpasses 4.5. The variation in bird diversity, richness and abundance across different habitats might be associated with vegetation composition that make chance in food preference, roosting and nesting sites, predation pressure and disturbance (Hossain & Aditya, 2016, Kiros et al., 2018). Crop composition and farming intensity also influence the species richness and abundance of birds in the agricultural fields (Cunningham *et al*., 2013; Malik *et al*., 2015).

Table 6. Diversity of Bird species recorded Sunflower field during rabi 2021-22 at BARI research field, Gazipur.

Diversity Index	Time of the days		
	Morning	Noon	Afternoon
Margalef Species richness index (*d*)	4.93	3.64	3.08
Shannon-Wiener Diversity Index (H)	1.86	0.83	1.26
Simpson's Diversity Index (D)	0.81	0.41	0.59
Evenness Index (E)	0.7	0.37	0.64
Simpson Dominance Index (C)	0.19	0.59	0.40

Table7. Cost and return analysis as influenced by using different repellent

Treatment	Total yield (t ha-1)	Gross return (Tk. ha^{-1})	TVC (Tk. ha^{-1})	Gross margin (Tk. ha^{-1})	BCR
Multicolour reflecting ribbon	1.92	115200	79455	35745	1.45
Plastic bottle windmill	2.00	120000	80455	39545	1.49
Four side nylon netting	1.98	118800	81955	36845	1.45
Untreated control	1.69	101400	73205	28195	1.39

Selling Price Sunflower= Tk 60/ kg

The gross margin and benefit cost ratio (BCR) varied depending on the cost of using different repellent tools in the study. The maximum gross margin (Tk. 39545 ha^{-1}) was recorded from Plastic bottle windmill used plot followed by Multocoloured reflective ribbon (35745 ha^{-1}) and Four side nylon netting (36845 ha^{-1}), Similarly the maximum benefit cost ratio (1.49) was calculated from Plastic bottle windmill used plot followed by Multocoloured reflective ribbon, (1.45) Four side nylon netting (1.45) while the minimum (1.39) was in control (Table 7).

Conclusion

From the study is revealed that lower number of head and plant damage bird were recorded in different netting than control and higher yield was recorded in netting treated plot. Maximum number of bird visited in the morning and afternoon than noon. The present study is the first scientific documentation of avifaunal diversity of sunflower field, BARI, Gazipur. The findings of the present study can be used as a baseline data for further research on conservation and management of existing bird species in the agricultural landscapes.

References

Abdar, M.R. 2014. Seasonal diversity of birds and ecosystem services in agricultural area of Western Ghats, Maharashtra state, India. *Journal of Environmental Science, Toxicology and Food Technology* 8(1): 100–105.

Anonymous, 2012. Banglapedia: The National Encyclopedia of Bangladesh, https://en.banglapedia.org/index.php/Bird.

Bibi, F., & Ali, Z. 2013. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. The Journal of Animal & Plant Sciences, 23(2): 469–474.

Bomford M. 1992. Review of research on control of bird pests in Australia. Pages 93–96 in Borrecco JE, Marsh RE, eds. Proceedings of the Fifteenth Vertebrate Pest Conference. University of California Press.

Bucher E.,H. 1992. Neotropical parrots as agricultural pests. Pages 201–219 in Bissinger SR, Snyder NRF, eds. New World Parrots in Crisis: Solutions from Conservation Biology. Smithsonian Institution Press.

Clements, J. F., T. S. Schulenberg, M. J. Iliff, S. M. Billerman, T. A. Fredericks, B. L. Sullivan, and C. L. Wood. 2019. The eBird/Clements Checklist of Birds of the World: v2019. https://www.birds. cornell.edu /clementschecklist/download/.

Cunningham, S.A., Attwood, S.J., Bawa, K.S., Benton, T.G., Broadhurst, L.M., Didham, R.K., McIntyre, S., Perfecto, I., Samways, M.J., Tscharntke, T. and Vandermeer, J. 2013. To close the yield-gap while saving biodiversity will require multiple locally relevant strategies. Agriculture, Ecosystems & Environment 173: 20-27.

De Grazio J.W. 1989. Pest birds: An international perspective. Pages 1–8 in Bruggers RL, Elliot CCH, eds. *Quelea quelea*: Africa's Bird Pest. Oxford University Press.

Elsen, P.R., R. Kalyanaraman, K. Ramesh & D.S. Wilcove. 2016. The importance of agricultural lands for Himalayan birds in winter. *Conservation Biology* 31(2): 416–426. https://doi.org /10.1111/cobi.12812

Ferdous,, M. J., Karim M. R., Hossain M. A., Rahman M. A. and Iqbal M. M. 2015. Fin fish assemblage and biodiversity status of carps on halda river, Bangladesh. Annals of Veterinary and Animal Science, 2(6):151-161.

Hossain, A. & G. Aditya. 2016. Avian diversity in agricultural landscape: Records from Burdwan, West Bengal, India. *Proceedings of the Zoological Society* 69(1): 38–51. https://doi.org/10.1007/s12595-014-0118-3.

Issa, M.A.A. 2019. Diversity and abundance of wild birds species' in two different habitats at Sharkia Governorate, Egypt. Issa The Journal of Basic and Applied Zoology 80:34. https://doi.org/10.1186/s41936-019-0103-5

Jayasimhan, C.S. & P. Pramod. 2019. Diversity and temporal variation of the bird community in paddy fields of Kadhiramangalam, Tamil Nadu, India. *Journal of Threatened Taxa* 11(10): 14279–14291. https://doi.org/10.11609/jott.4241.11.10.14279-14291

Khaleghizadeh, A. 2011. Effect of morphological traits of plant, head and seed of sunflower hybrids on house sparrow damage rate. Crop Protection 30: 360–367.

Kiros, S., Afework, B., & Legese, K. 2018. A preliminary study on bird diversity and abundance from Wabe fragmented forests around Gubre subcity and Wolkite town, southwestern Ethiopia. International Journal of Avian & Wildlife Biology, 3(5): 333–340.

Krebs, C.H.J. 1989. Ecological methodology *Univ of British Columbia* Harper Collins Publisher 645p

Kumar, P. & S. Sahu. 2019. Avian Diversity in Agricultural Landscapes of District Panipat, Haryana, India. *Asian Journal of Conservation Biology*, 8(2):188-198.

Kumar, P. & S. Sahu. 2020. Composition, diversity and foraging guilds of avifauna in agricultural landscapes in Panipat, Haryana, India. *Journal of Threatened Taxa* 12(1): 15140–15153. https://doi. org/10.11609/jott.5267.12.1.15140-15153.

Lepage, D. 2021. Checklist of the birds of Bangladesh. Avibase, the world bird database. https://avibase.bsceoc.org/checklist.jsp?.

Linz, G.M, Hanzel, J.J. 1997. Birds and sunflower. Pages 381–394 in Schneiter AA, ed. Sunflower Technology and Production. American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. Agronomy Monograph no. 35.

Magurran, A.E. 1988. *Ecological Diversity and Its Measurements.* Croom Helm ltd., London.
Mahato, S., S. Mandal & D. Das. 2021. An appraisal of avian species diversity in and around Purulia Town, West Bengal, India. Journal of Threatened Taxa, 13(3): 17906–17917. https://DOI: 10.11609 /jott.4733.13.3.17906-17917
Mallik, A., Chand, D.S., Singh, A. and Parida, S.P. 2015. Studies on avifauna diversity of agronomy field of O.U.A.T campus, Bhubaneswar, India. Current Life Sciences 1(2): 46-57.
Mukhopadhyay, S. & S. Mazumdar. 2017. Composition, diversity and foraging guilds of avifauna in a suburban area of southern West Bengal, India. *Ring* 39: 103–120. https://doi.org/10.1515/ ring-2017-0004
Narayana, B.L., V.V. Rao & V.V. Reddy. 2019. Composition of birds in agricultural landscapes Peddagattu and Sherpally area: a proposed uranium mining sites in Nalgonda, Telangana, India. *Proceedings of Zoological Society* 72(4):355–363. https://doi.org/10.1007/s12595-018-0276-9
Odum E.P. 1971. Fundamental of Ecologi, 3th Edition *Toppan Compani*, Ltd
Rodriguez, E.N, Bruggers, R.L, Bullard, R.W, Cook, R. 1995. An integrated strategy to decrease eared dove damage in sunflower crops. Pages 409–421 in Mason JR, ed. Repellents in Wildlife Management: Proceedings of a Symposium. National Wildlife Research Center, Fort Collins, Colorado, USA.
Sundar, K.S.G. & S. Kittur. 2013. Can wetlands maintained for human use also help conserve biodiversity? Landscape-scale patterns of bird use of wetlands in an agricultural landscape in north India. *Biological Conservation* 168: 49–56. https://doi.org/10.1016/j.biocon.2013 .09.016
Svensson, L., Mullarney, K., Zetterström, D., & Grant, P. J. 2009. Collins bird guide. Second edition. London: Harper Collins.
Ulfah, M, S. N. Fajri, M. Nasir, K. Hamsah and S. Purnawan. 2019. Diversity, evenness and dominance index reef fish in Krueng Raya Water, Aceh Besar. IOP Conf. Series: Earth and Environmental Science 348: 012074.
Yashmita-Ulman & M. Singh. 2021. Bird composition, diversity and foraging guilds in agricultural landscapes: a case study from eastern Uttar Pradesh, India. *Journal of Threatened Taxa* 13(8): 19011–19028. https://doi.org/10.11609/jott.7089.13.8.19011-19028.
You, M., Vasseur, L., Régnière, J., & Zheng, Y. 2009. The three dimensions of species diversity. The Open Conservation Biology Journal, 3: 82–88.

FIELD EVALUATION OF RODENTICIDE FOR CONTROLLING RATS

M. S. Alam and A.T.M. Hasanuzzaman

Abstract

The experiment was conducted at Vertebrate Pest Division, BARI, Gazipur and ARS, Rajbari, Dinajpur to study the effectiveness of ‘Bromadon, Rat Finix (Bromadiolone) and Ratkil (Zinc phosphide) supplied from company. In field trial test all the rodenticide showed more than 80% rodent control success was recorded. The average poison bait consumption was 1.0 to 1.17 g/rat/day in all the tested bait.

Introduction

Rat is the major vertebrate pest in Bangladesh. It causes serious damage to our crops in the field and in storage. According to Ahmed *et al*. (1986) rat cause 5.7 % losses to deepwater rice, and Sultana & Jaeger (1992) described wheat and rice losses as 2.3 and 1.9 % of the expected yields in two areas of Bangladesh between 1986 and 1988 respectively. Rats are major problem in the poultry sector too. They share the poultry food from the food tray, damage the eggs, chicken and also destroy the food in the storages. They damage the floor of the farm by extensive burrowing and also attack the young birds (Roy *et al*., 1987) and disseminate different kinds of diseases.

In Bangladesh, farmers commonly use zinc phosphide, aluminum phosphide and lanirat to control rodents. Trapping and flooding the burrows are also common practice among the farmers. Zinc phosphide bait is effective poison but creates bait shyness and also creates environmental pollution. Bait shyness problem was solved by the introduction of anticoagulant poison. In anticoagulant, rat does not associate poisoning symptoms with the bait material. As a result complete control of rodent population is possible with anticoagulant poison. Recently, Second generation single dose anticoagulant rodenticides like bromadiolone and brodifacoum are found very effective against many rodent species (Brooks, *et al*., 1974; Mathur and Prakash, 1981, Chopra *et al*., 1983; Buckle *et al*, 1984, Prashad *et al*, 1985).

Recently pesticide companies have submitted three sample namely 'Bromadon, Rat Finix and Ratkil, first two are bromadiolone and the last one is acute poison basically Zinc phosphide (80% a.i), for evaluating their rodenticidal properties. The present study was aimed at evaluating the efficacy of 'rodenticidal efficacy against field rat.

Material and methods

The experiment was conducted in the laboratory of Vertebrate Pest Division, BARI, Gazipur and ARS, Rajbari, Dinajpur during 2021-22. Two type of test was conducted for this study, choice feeding and field test. Choice feeding test was done previous year. This year only field test was done. Bandicoot rats, *Bandicota bengalensis* (Gray), were collected from Vertebrate Pest Division laboratory rat enclosure and the rats were reared in the rat enclosure for breeding purposes. Rats were kept in 40 X 25 X 18 cm rearing cage in the laboratory.

Choice test

The choice feeding tests were conducted in the laboratory using 20 (10 male and 10 female) acclimatized adult rats in each sample. Six hours starved rats were exposed individually to poison bait in a food cup for 24 hours. Two food cups were provided to each animal, one cup containing 10g of poison bait and the other containing 20g of plain wheat grains for each sample. Rodenticide was supplied for three consecutive days and the plain wheat grain was provided up to end of the experiment (up to 15 days). Spilled bait material or wheat grains were collected in a paper placed beneath the cages and weighted in both the tests. Water was supplied at ad libitum. Consumption of bait material or food and mortalities of the test rats were recorded every day.

Field test

Field test of all the three rodenticides were conducted in wheat field at ARS, Rajbari, Dinajpur. At booting stage of wheat, 60 active rat burrow systems were selected. The activity of burrow was confirmed by setting tracking tile. About 20 g of poison bait was applied near the burrow opening or runway as well as the premises of active burrow system. The poison bait was applied in the evening and application was continued for consecutive three days. After application, rodent activity was observed up to seven days. Then post treatment tile index data was taken. Efficacy of the treatment was judged on the basis of rodent activity.

Result and Discussion

Choice test: In case of Rat Finix and Bromadon out of ten male and ten female rats eight males and ten female rats were died within 3-4 days. The average bait consumption per rat per day was .1.358g and 01.79g respectively. The average mortality was 90% (Table 1). Seventeen rats were died out of 20 rats in case of Rat Finix and Bromadon. The average bait consumption per rat per day in case of male and female were 1.35g, 0.99g and 01.71g, 2.1g in Rat Finix and Bromadon respectively. The average mortality were 85% (Table 3).

Field test: Rat Finix and Bromadon showed a considerable reduction in rodent number in wheat field, Rajbari, Dinajpur. The average reduction of rodent number in both Rat Finix and Bromadon were observed 80-81.25% whereas the average reduction of rodent number in RAT KILLER was observed 80% in field test (Table 2). This finding is comparable to another result where Rahman and Brooks (1982) recorded 84 % reduction of rodent activities by applying zinc phosphide bait outside the burrow system inside house in Bangladesh. In another experiment, 80% mortality with Zinc phosphide bait was recorded for controlling *Nesokia indica* (Anonymous, 1994). Higher mortality (83.33%) with zinc phosphide bait was also reported by Haque (1993) for controlling *Nesokia indica* in the northern districts of Bangladesh. Hasanuzzaman et al., (2003) studied that 81.99 % reduction of rodent activities was recorded by applying lanirat bait (Bromadiolone 0.005%) outside the burrow system in poultry farm of Gazipur district in Bangladesh.

The results of the present field study indicated that the efficacy of all these supplied zinc phosphides and bromadiolone rodenticide were satisfactory and all these three rodenticides can be recommended for controlling field rats in Bangladesh.

Table1. Effect of "Choice test" on Bromadon and Rat Finix (Bromadiolone 0.005%) and Ratkil Zinc phosphide 80% on bandicoot rat *Bandicota bengalensis* (Gray) in VPD Laboratory, BARI, Gazipur during 2021-22.

Rodenticide	Rat Tasted	Rat Body Weight (g)	Avarage Consumption/rat/day(g)		Dead rat (no.)	Rat mortality (%)	Avaarge mortality (%)
			Poison bait	Plain bait			
RATKIL (Zinc phosphide 80%)	10 Males	211.45±5.43	1.01±0.14	8.32±0.49	10	100	100
	10 Females	161.32±5.43	0.93±0.16	10.31±0.41	10	100	
RAT FINIX (Bromadiolone 0.005%)	10 Males	204.58 ±7.91	2.01±0..21	9.73±0.11	8	80	85
	10 Females	158.87 ±3.39	1.79±0.11	10.19±0.27	9	90	
Bromadon (Bromadiolone 0.005%)	10 Males	200± 9.07	1.35±0.46	17.07±2.	9	90	90
	10 Females	222±10.72	0.99±0.19	11.79±1.9	9	90	

Table2. Field Efficacy of rodencide for controlling rodent using active burrow count method at Rajbari Dinajpur, and Shympur, Rajshahi during 2021-22.

Treatments	No. of pre-tretment Active burrow	No. of Post-Treatment Active burrow	% Population reduction
RATKIL (Zinc phosphide 80%)	80	14	82.50
RAT FINIX (Bromadiolone 0.005%)	80	15	81.25
Bromadon (Bromadiolone 0.005%)	80	16	80.0

References

Ahmed, M.S., Mian, M.Y, Haque, M. E & Brooks, J.E 1986. Estimating rat damage in deep water rice. Int. Rice Res. Newsl, 11(1), 23-24.

Brooks, J.E., Pethan, H., Hla, N., Walton, D.W., and Maung, M.T. 1979. Laboratory evaluation of rodenticides for use against South-East Asian commensal small mammals. World Health Organisation WHO/VBC/79. 720.

Buckle, A.P., Rowe, F.P., and Husin, A.R. 1984. Field trials of warfarin and brodifacoum wax block baits for the control of the rice field rat, Rattus agentiventer, in Penninsular Malaysia. Tropical Pest Management. 30, 51-58.

Chopra, G., Ahmad, N., and Prashad, V.R. 1983. Laboratory evaluation of supercaid (Bromadiolone) against three murid species. Indian journal of Plant Protection 11, 70-73.

Hasanuzzaman, A T M, M.Y. Mian and M.S. Alam., 2004. Rodent species composition and their control in poultry farm. Bangladesh J. entomol. 14(2), 61-67.

Mathur, R.P. and Prakash, J. 1981. Evaluation of brodifacoum against Tatera indica, Mariones hurrianae and *Rattus rattus*. Journal of Hygiene Cambridge 87, 178-184.

Prashad, V.R., Ahmad, N. and Chopra, G. 1985. Laboratory and field evaluation of brodifacoum for rodent control. International Biodeterioration 21, 107-112.

Roy, L.G., Singh R.K.T. and Singh, K.D. 1987. Rodent control in poultry farm near Imphal, Monipur, using Bromadiolone. Rodent Newsletter. 11(1-4), 6-8.

Sultana, P & Jaeger, M. M. 1992. Control strategies to reduce preharvest rat damage in Bangladesh. In: proc. 15 the Vertebr. pest conf. Newport Beach, California. 15, 261-267.

Appendix I: List of Scientists and Scientific Staffs of Vertebrate Pest Division BARI, Gazipur

Sl. No.	Name and Designation	Remarks
Scientists		
01.	Dr. Md. Shah Alam, Principal Scientific Officer	Divisional Head.
02.	Dr. A.T.M. Hasanuzzaman, Senior Scientific Officer	
Scientific staffs		
01.	Ferdhowshi Begum Scientific Assistance	
02.	Md. Shariful Islam Suman Lab. Technician	

APPENDIX II: **কর্মসম্পাদন সূচক, লক্ষ্যমাত্রা** এবং **অর্জন - ২০২১-২০২২ (সেকশন ৩)**

ক্রমিক নং	সূচক	একক	২০২১-২২ লক্ষ্যমাত্রা	২০২১-২২ (অর্জন)
১.	উদ্ভাবিত প্রযুক্তি	সংখ্যা	১	০১
২.	প্রশিক্ষিত কৃষক	সংখ্যা	৩০	৩০
৩.	স্থাপিত প্রদর্শনী	সংখ্যা	১	০১
৪.	আয়োজিত সেমিনার/ওয়ার্কশপ	সংখ্যা	১	০১
৫.	আয়োজিত মাঠ দিবস/ র‍্যালী	সংখ্যা	১	০১
৬.	বার্ষিক গবেষণা রিপোর্ট প্রকাশিত	সংখ্যা	১	০১
৭.	লিফলেট , বুকলেট , নিউজলেটার , জার্নাল , বুলেটিন , প্রকাশনা ইত্যাদি	সংখ্যা	১	০১
৮.	বিতরণকৃত ইদুর দমনের জন্য গবেষণাগারে তৈরি বিষটোপ	সংখ্যা	২০০	২০০
৯.	রেজিস্ট্রেশনের জন্য নতুন কীটনাশকের / ইঁদুরনাশকের জন্য মাঠ পরীক্ষা সম্পন্ন	সংখ্যা	০৫	০৫
১০.	কর্মকর্তাদের পরিদর্শনকৃত অনুন্নয়ন বাজেটের আওতায় কার্যক্রম	সংখ্যা	০৫	০৫
১১	কর্মকর্তাদের পরিদর্শনকৃত উন্নয়ন প্রকল্প ও কর্মসূচি এবং অনুন্নয়ন বাজেটের আওতায় কার্যক্রমের ওপর প্রদত্ত সুপারিশ বাস্তবায়নকৃত	%	১০০	১০০

APPENDIX III: List of Vertebrate Pest species and crops damaged in Bangladesh

Common Name	Scientific name	Crops damaged
Rodents		
Lesser bandicoot rat	*Bandicota bengalensis*	Most crops rice, wheat, barley, poultry
Greater bandicoot rat	*Bandicota indica*	Deepwater and boro rice
House/Roof/Black rat	*Rattus rattus*	Stored food, coconut
Norway rat	*Rattus norvegicus*	Stored food
Short-tailed mole rat	*Nesokia indica*	Sugarcane, other crops
House mouse	*Mus musculus*	Stored food and goods
Field mouse	*Mus booduga*	Grain crops, etc.
Soft-furred field rat	*Millardia meltada*	Rice, wheat, barley, etc.
Squirrels Five striped squirrel Three striped squirrel Brown squirrel	*Funambulus pennanti* *Funambulus palmarum* *Callosciurus pygerythrus*.	Coconut, ber, mango, betel nut, guava, other fruits
Porcupine Brush tailed porcupine Indian porcupine	*Atherurus macrourus* *Hystrix indica*	Pineapple, root and tuber crops, bark of trees.
Birds		
Blue rock pigeon	*Columba livia*	Wheat and other seeds in seed beds/sown fields
Jungle crow	*Corvus macrorhynchos*	Wheat, sprouts, maize cobs, ripened jackfruit and other fruits
House crow	*Corvus splendens*	Wheat sprouts, maize cobs, ripened fruits
Common myna	*Acridotheres tristis*	Wheat sprouts
Jungle myna	*Acridotheres fuscus*	Wheat sprouts
Pied myna	*Sturnus contra*	Wheat sprouts
Rose-ringed parakeet	*Psittacula krameria*	Maize cobs, matured rice, sunflower
Munia	*Lonchura spp.*	Millet, rice, etc.
Baya weaver	*Ploceus philippinus*	Millet, rice, etc.
House sparrow	*Passer domesticus*	Wheat, rice, etc.
Bulbul	*Pycnonotus* spp.	Vegetable of fruits
Bats		
Short-nosed fruit bat	*Cynopterus sphinx*	Most fruits
Flying fox	*Pteropus* sp.	Most fruits
Other wild vertebrate pest		
Golden jackal	*Canis aureus*	Sugarcane, maize, water melon, melon, jackfruit, poultry, etc.
Bengal fox	*Vulpes bengalensis*	Sugarcane, maize, water melon, melon, jackfruit, poultry, etc.
Wild pig/boar	*Sus scrofa*	Root crops, tubers, other plantations in hilly areas.
Asian elephant	*Elephas maximus*	Field crop, vegetables, rubber
Rabbit	*Lepus nigricollis*	Vegetables and grain crops, etc.

APPENDIX VI: List of Publication- (January 2021 to June 2022).

Booklet:

1. Alam, M. S. and A.T.M. Hasanuzzaman. 2021. Biological control of rodent through owl conservation (in Bengali). Vertebrate Pest Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. p11.
2. Alam, M. S., A.T.M. Hasanuzzaman, M. R. Talukder, M. A. Rahman, M. M. Rahman and G. Kibria. 2022. Rodent control techniques in floating bed. Vertebrate Pest Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. p15

Training Manual:

Alam, M. S. and A.T.M. Hasanuzzaman. 2021. Training Manual on Eco-friendly rodent management (In bengali), Vertebrate Pest Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. p31