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Management of rodent pests of rice fields in upper Brahmaputra valley of Assam

RK Borah* and D Baglari

Assam Agricultural University, Jorhat-785013, Assam, India
**Email : borahratul09@gmail.com*

ABSTRACT

Different management practices using botanical repellent, rodenticide and traps were evaluated in different crop growth stages against field rodents in terms of live burrow count (LBC ha^{-1}), trapping index (TI) as well as per cent cut tillers in both boro and sali rice, respectively. Among different treatments, application of ecodon solution @1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage followed by placement of sherman trap after 10 days of last application was found to be most effective in respect of reduction of live burrow (90.99% and 87.52%), trap index (68.11% and 67.20%) and cut tillers (75.16% and 73.10%) in both boro and sali rice, respectively. The next effective treatment was spraying of ecodon solution (1:50) on bunds at maximum tillering stage and just before panicle initiation stage followed by placement of sherman trap after 10 days of last application with a reduction of 78.32 per cent LBC ha^{-1}, 60.11 per cent trapping index and 69.05 per cent cut tillers in boro rice. The reduction percentage in respect of LBC ha^{-1}, trapping index and per cent cut tillers were 77.44, 58.01 and 67.13, respectively.

Key words: *rice fields, management, rodent, botanicals, trap*

Rodents cause considerable damage to rice crop in India and other South Asian countries (Karim, 1994). About 115 species of rodents occur in India and of these, 18 species are pests (Parshad *et al*., 2007). In South Asia, the lesser bandicoot rat, *Bandicota bengalensis* Gray is predominant in irrigated crop fields and grassland. Ecologically, India is one of the most diversified country harbouring at least 52 genera and 18 species of rodents (Roonwal, 1987). In Assam, rice is grown under three seasons, *ahu* (March to June), *sali* (June to November/December) and *boro* (November to April) which occupy 23, 70 and 7 per cent of total rice area of the state (Sharma *et al.*, 2001). The productivity of rice in Assam during 2012-13 was 1317 and 2055 kg ha^{-1} in autumn and winter rice, respectively, whereas the projection of anticipated productivity of both autumn and winter rice during 2013-14 was 1342 and 2250 kg ha^{-1}, respectively (Borkakati, 2013). The productivity of rice in Assam which is far below national average could be due to various constrains, including physical input related and biotic and abiotic stresses (Sharma *et al*., 2001). In this backdrop, field experiments were undertaken to study the effect of botanicals, traps and rodenticides applied at different schedules against *B. bangalensis*, the predominant rodent species in both *boro* and *sali* rice.

MATERIALS AND METHODS

The field trials were conducted in the rice fields of Regional Agricultural Research Station, Titabar, Assam Agricultural University, Jorhat in both '*boro*' and '*sali*' season, during 2011-12 and 2012-13, respectively. The soil type of both the fields is weakly acidic, sandy loam of alluvium.

Seven treatments with botanical, sherman traps and rodenticides were evaluated for their efficacy against field rodents at different growth stages of rice crop under irrigated rice ecosystem. Each treatment was replicated thrice representing single block size of 60

m x 50 m. A gap of 20 m was maintained within blocks and replications. The treatments were spraying of ecodon (1:50) on moistened strips along the field bunds at maximum tillering stage and just before panicle initiation stage; application of ecodon solution (1:50) @1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage; spraying of ecodon (1:50) on moistened strips along the bunds at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application; application of ecodon solution (1:50) @1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application; zinc phosphide (2.5%) baiting at just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application Sherman; trap (30 traps ha^{-1}) at tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage and control.

Ecodon solution was prepared by mixing 1 litre of ecodon in 50 litres of water and sprayed on the moistened strip along the field bunds. In case of burrow application, the ecodon solution was applied in the burrow @ 1litre burrow^{-1}.

The bait materials used for zinc phosphide baiting were broken rice 955 g, mustard oil 20 ml and 25 g of zinc phosphide. Banana sheath was used as bait stations which were placed near the live burrows. Pre-baiting with plain bait (without poison) for two days was done in case of zinc phosphide.

The rodent incidence was worked out in terms of (LBC ha^{-1}), trapping index (No. of rodents trapped 100 traps^{-1} night^{-1}) as well as per cent cut tillers damage. For the estimation of live burrow density LBC method described by Kumar and Pathak (2002) was practiced. For trap index, the traps were set in two trap lines each of ten traps. Trapping was continued for 72 hours. Traps were checked after 24 hours interval. Trapped rodents were removed, traps reset by replenishing the bait. Trapping index was calculated as follows,

Trap index = Number of rodents trapped 100 traps^{-1} night^{-1}

Damage incidence (% cut tillers) was recorded by diagonal method (Rajendran *et al*., 2007).

The observations on live burrow count, trap index and cut tillers were recorded 1 day before and 15 days after treatments.

RESULTS AND DISCUSSION

The per cent reduction in rodent population due to spraying of ecodon (1:50) on bund at maximum tillering and just before panicle initiation stage was 56.52 per cent LBC ha^{-1} and 44.94 per cent trapping index and spraying of ecodon (1:50) on bund at maximum tillering and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application was 78.32 per cent LBC ha^{-1} and 60.11 per cent trapping index, respectively (Table 1). Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage recorded reduction of 68.06 per cent LBC ha^{-1} and 51.78 per cent trapping index whereas, the application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application showed the best treatment with the highest reduction in rodent population (90.99 per cent LBC ha^{-1} and 68.11 per cent trapping index). Application of zinc phosphide (2.5%) baiting at just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application recorded reduction of 71.75 per cent LBC ha^{-1} and 55.16 per cent trapping index. The placement of sherman trap (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage recorded minimum reduction of rodent population (34.64% LBC ha^{-1} and 25.89% trapping index). The data recorded on control revealed that rodent population in terms of LBC ha^{-1} and trapping index increased on upward trend as the crop stage advanced. The LBC ha^{-1} (8.33) was recorded at maximum tillering stage increased to 23.66 at milky stage where as trapping index of 3.53 was recorded at maximum tillering stage increased to 7.33 at milky stage.

The per cent reduction in rodent population due to spraying of ecodon (1:50) on bund at maximum tillering and just before panicle initiation stage was 50.04 per cent LBC ha^{-1} and 45.35% T1 and spraying of ecodon (1:50) on bund at maximum tillering and just before panicle initiation stage + sherman trap (30

Table1. Effect of different treatments on live burrow count (LBC) and trap index (TI) in *boro* rice during 2011-12

Treatments	Pre-treatment		Post-treatment		Reduction in population (%)	
	LBC ha^{-1}	TI	LBC ha^{-1}	TI	LBC ha^{-1}	TI
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage	7.66	3.56	3.33	1.96	56.52	44.94
Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage	8.33	3.36	2.66	1.62	68.06	51.78
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	7.66	3.36	1.66	1.34	78.32	60.11
Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	7.33	3.23	0.66	1.03	90.99	68.11
Zinc phosphide (2.5%) baiting at just before panicle initiation stage +sherman trap (30 traps ha^{-1}) after 10 days of last application	15.66	5.13	4.66	2.30	71.75	55.16
Sherman trap (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage	8.66	3.63	5.66	2.83	34.64	25.89
Control	8.33	3.53	23.66	7.33		
CD (P<0.05)	1.47	0.53	0.38	0.25		

LBC = Live burrow count, TI = Trap index

traps ha^{-1}) after 10 days of last application recorded reduction of 77.44 per cent LBC ha^{-1} and 58.01% T1 respectively (Table 2). Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage recorded reduction of 67.69 per cent LBC ha^{-1} and 50.11 per cent trapping index, and application of ecodon solution @ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application recorded the highest reduction in rodent population i.e. 87.52 LBC ha^{-1} and 67.20% trapping index. Baiting with zinc phosphide (2.5%) at just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application recorded reduction of 73.11 per cent LBC ha^{-1} and 54.05 per cent trapping index. The placement of sherman traps (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage recorded minimum reduction of rodent population i.e. 35.52 per cent LBC ha^{-1} and 21.92 per cent trapping index. The data recorded on control revealed that rodent population in terms of LBC ha^{-1} and trapping index increased with an advancement of crop. The LBC ha^{-1} (10.66) was recorded at maximum tillering stage increased to 25.66 at milky stage where as trap index of 4.53 was recorded at maximum tillering stage increased to 9.06 at milky stage.

Among the different treatments, the best treatment with highest reduction in rodent population (90.99% LBC ha^{-1} and 68.11% trapping index) was application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage followed by placement of sherman trap after 10 days of last application during *boro* season and the percentage reduction was 87.52 LBC ha^{-1} and 67.20 trapping index in *sali* season. It has also been reported that the castor based repellent 'ecodon' recorded higher control success at both tillering and panicle initiation stages of the crop growth with 44.4 and 48.7 per cent and with 53.9 and 55.4 per cent at 7 and 15 days after treatment, respectively and offered relatively better protection for a longer period over other botanicals (Anon., 2012). Field trials with castor based herbal repellent (ecodon) showed higher repellency (27.60- 40.70%) against rice rodents followed by castor oil 10 per cent (8.3-40.70%) and pongamia oil 10 per cent (4.8-32.8%) in Godavari delta region of Andhra Pradesh (Anon., 2009).

Table 2. Effect of different treatments on live burrow count (LBC) and trap index (TI) in *sali* rice during 2012-13

Treatments	Pre-treatment		Post-treatment		Reduction in population (%)	
	LBC ha^{-1}	TI	LBC ha^{-1}	TI	LBC ha^{-1}	TI
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage	11.33	4.63	5.66	2.53	50.04	45.35
Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage	11.33	4.33	3.66	2.16	67.69	50.11
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	10.33	4.43	2.33	1.83	77.44	58.01
Application of ecodon solution@ 1 litre burrow^{-1} at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	10.66	4.36	1.33	1.43	87.52	67.20
Zinc phosphide (2.5%) baiting at just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	17.33	6.66	4.66	3.06	73.11	54.05
Sherman trap (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage	10.33	4.56	6.66	3.56	35.52	21.92
Control	10.66	4.53	25.66	9.06		
CD (P<0.05))	1.64	0.45	0.86	0.31		

LBC= Live burrow count, TI= Trap index

The second best treatment in respect of reduction in rodent population in terms of LBC/ha and trapping index was spraying of ecodon solution (1:50) on bunds at maximum tillering stage and just before panicle initiation stage followed by placement of sherman trap (30 traps ha^{-1}) after 10 days of last application where the per cent reduction of LBC/ha and trapping index was 78.32 and 60.11 per cent, respectively in case of *boro* rice and 77.44 per cent reduction in LBC/ha and 58.01 per cent reduction in trapping index in *sali* rice. Bunds application of castor based ecodon (an herbal repellent) also checked the rodent population (25-45%) (Anon., 2011-12).

Baiting with zinc phosphide at just before panicle initiation stage followed by placement of sherman trap (30 traps/ha) after 10 days of last application reduced the LBC ha^{-1} and trapping index to 71.75 and 55.16 per cent respectively in *boro* rice. Whereas, in *sali* rice, 73.11 per cent reduction in LBC/ha and 54.05 per cent reduction in trapping index was recorded. The results is in conformity with the results obtained by Rana (1994) who reported that treatment of bromadiolone and zinc phosphide provided 48 and 41 per cent control success in poultry farm respectively. Parshad *et al*. (1994) also reported 65.0 to 100.0 per cent control success with trapping and baiting with zinc phosphide and anticoagulant rodenticides. Sheikher and Jain (1991) found that burrow baiting with zinc phosphide 2.5 per cent followed by bromadiolone 0.005 per cent after one month of treatment significantly control rodents and the control success was 93.1 per cent. The result is in conformity with the results obtained by Dahiya and Verma (1992), who reported that zinc phoshide 2.5 per cent grain bait and bromadiolone 0.005 per cent, each in ready-to-use wax cake, grains and flour gave 96.1 and 71.8, and 67.3 and 63.3 per cent mortality respectively. Ahmed (1996) also reported that control success of baiting with zinc phosphide followed by brodifacoum were 81.8 per cent in sugarcane and 59.4 per cent in adjoining wheat crop which were significantly better than those of single baiting with either of the rodenticides.

The results revealed that all the treatments were found effective against *Bandicota bengalensis* in reducing the damage in the field. The treatment with application of ecodon solution @ 1 litre/burrow at maximum tillering stage and just before panicle

initiation stage + sherman trap (30 traps/ha) after 10 days of last application was found to be most effective in reduction of cut tillers damage in both the season i.e. 75.16 per cent in *boro* and 73.10 per cent in *sali* rice (Table 3). The next best treatment was spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps/ha) after 10 days of last application which recorded 69.05 per cent reduction in cut tillers in *boro* rice and 67.13 per cent reduction in cut tillers in *sali* rice. Baiting with zinc phosphide (2.5%) at just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application recorded 65.06 per cent reduction in cut tillers in *boro* rice whereas, in *sali* rice, the cut tillers reduction percentage was 62.09. Application of ecodon solution @ 1 litre/burrow at maximum tillering stage and just before panicle initiation stage recorded 53.11 per cent and 52.14 per cent reduction of cut tillers in *boro* and *sali* rice respectively, where as spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage recorded 43.99 per cent reduction in cut tillers in *boro* rice and 41.03 per cent reduction in cut tillers in *sali* rice. Sudha Rani *et al* (2014) also reported that the non chemical and ecofriendly module (cultural practices+ecodon+trapping+burrow fumigation) was highly effective against rodent pests in rice. The placement of sherman trap (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage showed minimum reduction of cut tillers *i.e*. 16.11 per cent in *boro* rice and 14.19 per cent in *sali* rice, respectively. The data recorded on control revealed that rodent damage in terms of per cent cut tillers increased with the advancement of crop growth stage in both the seasons. The percentage of cut tillers, 4.26 and 4.73 recorded at maximum tillering stage in *boro* and *sali* rice

Table 3. Effect of different treatments on per cent cut tillers in *boro* (2011-12) and *sali* rice (2012-13)

Treatments	Cut tillers (%)					
	Pre-treatment		Post-treatment		Reduction in population (%)	
	boro rice	sali rice	boro rice	sali rice	boro rice	sali rice
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage	4.16	4.63	2.33	2.73	43.99	41.03
Application of ecodon solution@ 1 litre $burrow^{-1}$ at maximum tillering stage and just before panicle initiation stage	4.33	4.66	2.03	2.23	53.11	52.14
Spraying of ecodon (1:50) on bunds at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	4.46	4.93	1.38	1.62	69.05	67.13
Application of ecodon solution@ 1 litre $burrow^{-1}$ at maximum tillering stage and just before panicle initiation stage + sherman trap (30 traps ha^{-1}) after 10 days of last application	4.43	4.76	1.10	1.28	75.16	73.10
Zinc phosphide (2.5%) baiting at just before panicle initiation stage + sherman trap (30 traps / ha) after 10 days of last application	9.13	9.63	3.19	3.65	65.06	62.09
Sherman trap (30 traps ha^{-1}) at maximum tillering stage, just before panicle initiation stage and 10 days after panicle initiation stage	4.53	4.86	3.08	4.17	16.11	14.19
Control	4.26	4.73	8.17	10.77		
CD ($P<0.05$)	1.09	0.86	0.61	0.32		

respectively, increased to 8.17 and 10.77 per cent at milky stage in *boro* and *sali* season, respectively.

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