



## Effect of Rodenticides on Seed Yield of Rabi Crops in Arid Zone

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Received: December 2016

**Abstract:** The study was conducted in Bheenjwadia village of Osian Panchyat Samiti of Jodhpur district to disseminate the rodent management technology through demonstrations, trainings, group discussions, field day etc. Rodent control success (mean of 4 years) with single treatment of zinc phosphide (2%) was 68.53, 61.01 and 65.80% in mustard, wheat and cumin crops on 4<sup>th</sup> day after treatment. Rodent control success (mean of 4 years) with zinc phosphide bait (2% in bajra grain + 2% groundnut oil) followed by bromadiolone (0.005%) was the 70.89-72.87% on 4 DAT which increased further to 79.17-80.74% on 15 DAT. The seed yield of mustard, wheat and cumin increased by 4.9, 7.6 and 9.2% by using rodenticides. The net returns due to adoption of rodenticide baiting technology was of Rs. 2416.78, 3125.50 and 3500.00 ha<sup>-1</sup> in mustard, wheat and cumin, respectively as compared to control. Knowledge about the technology was also increased by 44.3% after conducting training program.

**Key words:** Rodent management, dissemination, rabi crops.

The arid region of India that is spread over 3,17,090 km<sup>2</sup> accounts for 12% area of the country. Western Rajasthan carries the onus of nearly 62% of arid area. Dryland farming is the main occupation of the people in Indian arid zone. In some areas where irrigation facility is available farmers cultivate irrigated crops also. The main irrigated crops grown in the area are mustard, wheat and cumin in rabi season. The productivity of these crops is low as compared to their potentiality. There is a considerable scope for increasing the production of rabi crops. Among various biotic factors, rodents are one of the main problems affecting their productivity in arid zone.

Rodents cause 5-10% loss of food grains annually during production, processing, storage and transport (Singleton, 2003; Hussain *et al.*, 2006; Fayenuwo *et al.*, 2007; Palis *et al.*, 2007; Meerburg and Kijlstra, 2008). They have been reported to cause a loss of 6-8% in paddy, 10-12% in wheat and 20-25% in sugarcane in India at pre-harvest stage (Chattopadhyay *et al.*, 2010; Singla and Babbar, 2010, 2012; Singla and Parshad, 2010). Loss due to rodents can be saved through adoption of rodent management technologies. However, farmers of arid zone are not much aware about this technology. Keeping this in view, Beenjwadia village of Jodhpur district was selected for dissemination of rodent

management technology and its impact on rabi crops following various extension approaches.

### Materials and Methods

The study was conducted in Beenjwadia village of Jodhpur district. Farmers of the village grow mustard, wheat and cumin in rabi season. The productivity of these crops is low. Among the biotic factors, rodents are one of the main problems in this village. Farmers are not much aware about rodent control technology. Keeping this in view, the village was selected under the transfer of technology program of CAZRI, Jodhpur for dissemination of the rodent management technology to farmers. Various extension tools like demonstrations, training, group discussion, field days etc. were used for dissemination of the technology. Rodenticidal demonstrations were conducted at 15 farmer's field on mustard, wheat and cumin. In demonstrations four treatments i.e. zinc phosphide (2%), bromadiolone (0.005%), zinc phosphide (2%), + bromadiolone (0.005%), and control were taken.

Rodent surveys and 15 rodenticidal demonstrations on rodent management technologies along with evaluations were conducted at farmer's field on mustard, wheat and cumin during last 4 years. The four treatments i.e. zinc phosphide (2%), bromadiolone (0.005%), zinc phosphide (2%) + bromadiolone (0.005%) and control were taken.

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For preparing the baits, pearl millet grain and groundnut oil was used. For one kg poison bait, 960 g pearl millet, 20 g of oil and 20 g of rodenticides was used. Control success was calculated based on live burrow count before and after the treatment.

Impact of training was also assessed through structured schedule by interviewing 45 farmers before and after the training program. Besides these, group discussion and field days were also organized for creating awareness about the rodent problem and its management.

## Results and Discussion

### Field demonstrations

Besides rodenticidal bait preparation and applications, the field demonstrations included practical exposure of the farmers about identification of rodent burrows of the rodent species in and around crop fields and also the live pest rodents. Assessment of rodent infestation and efficacy of poison bait treatments (based on live burrow count) was also demonstrated. The demonstrations were conducted for four years (2010-11 to 2013-14).

### Effect of rodenticidal treatments on control success

Rodents survey, and fifteen demonstration on rabi crops on rodent management technologies and rodenticidal evaluations were conducted during rabi 2010-11 to 2013-14 at farmers' fields in Bheenjwadia village of Jodhpur district. The studies revealed infestation of two major rodent species viz., Indian desert gerbil, *Meriones hurrianae* and Indian gerbil, *Tatera indica* in the crop fields. The level of infestation was 52-66 burrow ha<sup>-1</sup> in rabi crops. Before undertaking field demonstrations, on farm training on rodent management on extent of rodent problem, the rodent species of the region, techniques for preparation and application of poison baits and precautions in their use was organized. More than 75 farmers were exposed to rodent management technologies.

The results of the field demonstrations on rabi crops indicated that rodent control success with zinc phosphide was 68.53, 61.01 and 65.80% in mustard, wheat and cumin, respectively on 4<sup>th</sup> day after treatment, whereas with bromadiolone it was only 23.86,

Table 1. Effect of rodenticidal treatment on rodent control success at Bheenjwadia village

Crops Treatments	No of burrows treated (ha <sup>-1</sup> )	Control success (%)								Mean control success (%) 4 years	
		2010-11		2011-12		2012-13		2013-14			
		4 DAT	15 DAT	4 DAT	15 DAT	4 DAT	15 DAT	4 DAT	15 DAT	4 DAT	15 DAT
Mustard											
Zinc phosphide	53.50	-	-	67.27	57.41	68.52	57.41	69.81	58.49	68.53	57.77
Bromadiolone	51.25	-	-	23.07	61.53	25.00	61.54	23.53	60.78	23.86	61.28
Zinc phosphide + Bromadiolone	54.75	-	-	73.68	78.94	72.73	81.82	72.22	81.48	72.87	80.74
Control	48.00	-	-	-6.25	-14.58	-6.38	-12.77	-4.16	-8.33	-5.59	-11.89
Wheat											
Zinc phosphide	56.60	53.85	50.76	62.50	55.35	62.26	54.72	65.45	54.54	61.01	53.84
Bromadiolone	52.40	27.77	68.52	27.78	64.81	21.57	62.75	21.15	63.46	24.56	64.88
Zinc phosphide + Bromadiolone	52.20	70.00	82.00	72.00	80.00	71.15	76.92	70.37	77.77	70.88	79.17
Control	52.40	0.0	0.0	-5.45	-18.18	-12.0	-16.00	-6.00	-12.00	-5.86	-11.54
Cumin											
Zinc phosphide	56.00	64.28	55.35	63.79	51.72	67.86	51.79	67.27	56.36	65.80	53.80
Bromadiolone	53.20	22.00	72.00	24.56	63.15	27.78	61.11	28.84	59.61	25.79	63.96
Zinc phosphide + Bromadiolone	52.60	76.30	78.88	71.15	76.92	73.58	79.25	70.37	81.48	72.85	79.22
Control	50.00	-12.50	-17.24	-9.26	-14.81	-10.20	-16.33	-8.16	-14.28	-10.03	-15.66

DAT = Days after treatment.

Table 2. Effect of rodenticidal treatment on seed yield of rabi crops

Crop Treatment	No of burrows treated (ha <sup>-1</sup> )	2010-11		2011-12		2012-13		2013-14		Mean of 4 years	
		Yield (kg ha <sup>-1</sup> )	Increase in yield (%)	Yield (kg ha <sup>-1</sup> )	Increase in yield (%)	Yield (kg ha <sup>-1</sup> )	Increase in yield (%)	Yield (kg ha <sup>-1</sup> )	Increase in yield (%)	Yield (kg ha <sup>-1</sup> )	Increase in yield (%)
Mustard											
Zinc phosphide	53.75	-	-	1865	5.9	2075	4.6	1940	4.0	1960.00	4.9
Control	48.00	-	-	1760	-	1980	-	1865	-	1868.33	-
Wheat											
Zinc phosphide	55.75	3750	7.1	3545	8.5	3609	6.9	3580	7.2	3621.00	7.6
Control	53.00	3500	-	3266	-	3360	-	3340	-	3366.50	-
Cumin											
Zinc phosphide	57.75	595	10.2	585	8.9	360	8.3	460	8.2	500.00	9.2
Control	51.75	540	-	537	-	330	-	425	-	458.00	-

24.56 and 25.79% in respective crops (Table 1). However being a chronic rodenticide, the success with bromadiolone treatment increased to 61.28, 64.88 and 63.96% after 15 day of first treatment. The double baiting where acute rodenticide (zinc phosphide) was integrated with application of chronic bromadiolone, the success rate was 70.88-72.87% on 4 DAT which increased further to 79.17-80.74% (15 DAT). In the untreated control plots the control success decreased from -11.54 to -15.66% during this period. The above findings are in conformity with the findings reported by Tripathi *et al.* (2004).

The rodent pest population showed increasing trends in the untreated control fields of all the crops due to migration from surrounding areas. In the treated fields the migrating pest populations were also managed due to sustained effects of anticoagulant rodenticide baiting.

#### Effect of rodenticidal treatments on seed yield

Studies indicated that rodenticidal treatments had direct impact on yield of all the test crops due to management of rodents (Table 2). The mean seed yield of mustard was 1960.00 kg ha<sup>-1</sup> in treated fields as compared to 1868.33 kg ha<sup>-1</sup> in control fields. The seed yield of mustard increased from 4.02 to 5.96% with mean 4.9%. In wheat crop, the mean seed yield was 3621 kg ha<sup>-1</sup> in treated fields as compared to 3366.50 kg ha<sup>-1</sup> in control fields. The seed yield of wheat increased from 6.9 to 8.5% with mean 7.6%. In case of cumin, the mean seed yield was 500 kg ha<sup>-1</sup> in treated fields as compared to 458 kg ha<sup>-1</sup> in control fields. The seed yield of cumin increased varied from 8.2 to 10.2% with mean 9.2% (Table 2).

#### Net returns

The data presented in Table 3 indicated that application of rodenticides in mustard, resulted

Table 3. Effect of rodenticides treatment on the net returns in rabi crops (2010-11 to 2013-14)

Crop	Treatment	Yield (kg ha <sup>-1</sup> )	Yield increased over the treatment (kg ha <sup>-1</sup> )	Cost of treatment (Rs. ha <sup>-1</sup> )	Gross returns due to treatments (Rs. ha <sup>-1</sup> )	Net profit due to treatment (Rs. ha <sup>-1</sup> )
Mustard	With rodenticides	1960.00	91.67	700	3116.78	2416.78
	Control	1868.33	-	-	-	-
Wheat	With rodenticides	3621.00	255.50	700	3832.50	3125.50
	Control	3365.50	-	-	-	-
Cumin	With rodenticides	500.00	42.00	700	4200.00	3500.00
	Control	458.00	-	-	-	-

Note: Rate of mustard Rs. 34 kg<sup>-1</sup>, wheat 15 kg<sup>-1</sup> and cumin 100 kg<sup>-1</sup>.

in a net returns of Rs. 2416.78 ha<sup>-1</sup> as compared to control. In case of wheat and cumin, net returns were Rs. 3125.50 and Rs. 3500 ha<sup>-1</sup> as compared to control (Table 3).

### Farmers training

As part of capacity building and awareness program, five, on-farm trainings on 'Rodent Management' were organized in adopted village during 2010-11 to 2013-14 in participatory and interactive modes. Around 75 farmers were exposed about the rodent pest species of the region; rodent problem in agriculture, storage and public health; diagnostics of the problem; non-chemical rodent control techniques; rodenticides their bait preparation and applications and precautions in handling rodenticides.

Impact of two training on rodent management was also assessed. Data presented in Table 4 revealed that before training program, 42.9, 51.4 and 5.7% farmers possessed low, medium and high knowledge respectively, whereas after training program, maximum farmers belonged to medium (54.3%) knowledge category followed by 34.3% in high and 11.4% in low knowledge category. Before conducting training program, mean knowledge was 47.6% which increased up to 68.7% after conducting the training (Table 4).

Table 4. Knowledge level of farmers regarding rodent control in Bheenjawadia village

Knowledge level	Before training		After training	
	F	%	F	%
Low (below 4 score)	15	42.9	4	11.4
Medium (5 to 8 score)	18	51.4	19	54.3
High (above 8 score)	2	5.7	12	34.3
Total	35	100.0	35	100.0
Mean knowledge	47.6%		68.7%	

### Conclusions

On the basis of 4 year long study it may be concluded that the treatments with zinc phosphide (2%) followed by bromadiolone (0.005%) in baits prepared in pearl millet using groundnut oil as additive may be recommended for management of rodent pest in rabi crops.

The double baiting method integrating acute and chronic rodenticides fetched highest rodent control success of 80.74% mustard, 79.17% (wheat) and 79.22% (cumin) on 15<sup>th</sup> day after treatment. The seed yield of rabi crops also increased by 4.90 to 9.17% due to rodenticidal treatment over control. Extension approaches, viz., demonstration, training, group discussion and field day proved effective for dissemination of the rodent management technologies. Therefore, based on the findings the farmers may be motivated to adopt rodent management technologies to enhance crop yields.

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