J. Hortl. Sci.
Vol. 5 (1): 64-67, 2010

Incidence of rodent pests in cumin (*Cuminum cyminum* L.) and their management

Vipin Chaudhary and R.S. Tripathi[1]
Directorate of Medicinal and Aromatic Plants Research
Boriavi-387 310, Anand
E-mail: vipin_cima@yahoo.com

ABSTRACT

Infestation pattern and extent of damage by rodent pests and their management in cumin crop using second-generation anticoagulant rodenticides were studied at farmers' fields in Jodhpur district. Monthly trapping throughout the crop season revealed presence of four species, viz., *Tatera indica* (45.16%), *Meriones hurrianae* (29.03%), *Gerbillus gleadowi* and, an arboreal species, *Funambulus pennanti* (25.81%). Damage to cumin crop was almost on par at the vegetative growth stage and flowering stage, recording 11.00 and 13.50% reduction in plant stand, respectively. Efficacy of two anticoagulant rodenticides viz., difethiaone (0.0025%) and bromadiolone (0.005%) was evaluated by two census methods simultaneously, viz., live burrow count (LBC) and census baiting (CB). Two treatments of either of the anticoagulants, one at vegetative growth and another at flowering stage, resulted in >80% reduction in pest rodent population. Cost:benefit ratio obtained with bromadiolone (0.005%) baiting was 1:10.8. Thus, poison baiting with anticoagulant rodenticides may be practiced twice at (i) vegetative growth and (ii) flowering stage, for effective rodent management in cumin.

Key words: Rodents, cumin, anticoagulant, rodenticide, bromadiolone

INTRODUCTION

India, 'the land of spices' enjoys a pre-eminent position in the worlds spice trade. Over 60% of all spices are grown in India in almost every State and Union Territory owing to varying climatic conditions. Rajasthan is a major producer of seed spices (coriander, cumin, fenugreek, fennel, etc.) in the country totalling about 45% area under these crops. In western Rajasthan cultivation of cumin in *rabi* is predominant due to the crop's requirement for moderately-cool and dry climate with low humidity. Rajasthan alone produces 56% of the cumin in the country (Sree Kumar, 1994). Average yield of cumin is 0.5 t ha^{-1}, which is quite low, and can be potentially increased to 0.7-0.8 t ha^{-1} by protecting the crop against pests and disease and by using improved varieties. Among various pests, field rodents take a heavy toll in cumin at pre-harvest stages. Arid lands support very high populations of rodents which cause immense losses to various production systems (Tripathi and Chaudhary, 2006). Rodents start their destructive activity from the time of crop-sowing and continue until harvest. On an average, 5-10% damage is attributed to rodents in various field crops. However, such information is lacking in seed spices in general, and cumin in particular; therefore, the present study was attempted to work out damage caused by and infestation pattern of rodent pests in the cumin crop, and their management using second generation anticoagulant rodenticides.

MATERIAL AND METHODS

The study was conducted at farmers' fields in Rampura village of Jodhpur district (73.03^{0}E and 26.29^{0}N). The crop was sown during November, 2005 and harvested in March-April, 2006.

Rodent species composition and infestation pattern: Rodents were live-trapped by laying Sherman traps during the crop season for three consecutive nights in the third week of every month. Rodent species were identified and trap indices (No. of rodents trapped /100traps /night) for each species were worked out. Live-burrow count method was also employed to study the pattern of infestation at different crop-growth stages.

Damage estimation: Six plots of 0.5ha were selected at different places for estimation of damage. In each plot, ten randomly selected samples of 1 m^2 each were taken on transect along the diagonal. Damage to the plant stand was assessed at vegetative growth stage and flowering/fruit set

[1]AINP on Rodent Control, Central Arid Zone Research Institute, Jodhpur - 342 003

stage by counting the number of damaged and healthy plants along live- burrows in each sample. Damage to a plant stand at the respective crop-growth stage was estimated as:

$$\% \text{ damage} = \frac{\text{No. of damaged plants}}{\text{Total no. of plants (damaged + healthy)}} \times 100$$

Rodenticide evaluation: Two second-generation anticoagulant rodenticides, namely, difethialone (0.0025%) and bromadiolone (0.005%) were evaluated for managing rodents infesting the cumin crop. The rodenticial trials were carried out in three replicates each of 0.5 ha with a gap of 25 m between subsequent replicates. An area of the same size, well- separated by a railway track of about 200 m, was left as the control/reference plot. Rodenticide treatments were given at two different stages of crop-growth, or, as pulsed treatment. The first treatment was given at vegetative-growth stage and the second treatment at flowering stage. Post-treatment census was made 10 days after treatment because these rodenticides are known to yield maximum kill between 7 and 10 days. Test-rodenticides were baited randomly in the treatment plots. Two methods, viz., burrow and station-baiting were adopted for treating the study-plots. Prior to poison-baiting, the burrows in each treatment plot were plugged; on the next day, reopened (live) burrows were baited with 10-15 g of the respective poison-bait. Similarly, 50-100g test-bait was also placed in the bait-stations @ 15-20 stations per plot.

Efficacy of the rodenticide was assessed by two census methods viz., Live Burrow Count (LBC) and Census Baiting (CB) methods simultaneously, before and after treatment, following Chaudhary *et al* (2005). Rodent-control success with each test-rodenticide was worked out using the formula:

$$\text{Per cent control success} = 100\ (1-[(T_2 \times C_1)/(T_1 \times C_2)])$$

where

T_1= Pre-treatment population of rodents in treatment plots

T_2= Post-treatment population of rodents in treatment plots

C_1= Pre-treatment population of rodents in reference plots

C_2= Post-treatment population of rodents in reference plots

Data on pre- and post- treatment census following two methods, viz., live burrow count and census baiting were subjected to paired t-test for statistical analysis to compare rodent control success with rodenticide application. Similarly, Analysis of Variance (ANOVA) was applied for comparing the effectiveness of both methods of evaluation.

RESULTS AND DISCUSSION

Species composition and infestation pattern: Three rodent species, viz., *Tatera indica, Meriones hurrianae* and *Funambulus pennanti* were trapped from the crop-field and surrounding area. The trapping showed predominance of *T. indica* (45.16%), followed by *M. hurrianae* (29.03%) and *F. pennanti* (25.81%) (Table 1). However, live-burrows of *M. hurrianae* were in greater numbers in crop-fields. The species, being a diurnal rodent, recorded poor trap-ability, compared to the nocturnal *T. indica.* Among the three rodent species trapped, *T. indica* was seen to inhabit peripheral bunds while, *M. hurrianae* was found in the main field.

Initially, when the field was under preparation for sowing, rodent-burrow density was lower (7-22 burrows ha^{-1}) in the field than in the surrounding fallow land (56-87 burrows ha^{-1}). During germination and further vegetative growth upto the flowering stage, rodents from the surrounding fallow land established their population in the crop-field mainly in the peripheral regions, recording a burrow-density of 50-75 burrows ha^{-1}at 15 days after sowing. However, at maturity, when irrigation and other inter-cultural operations were resumed, the central portion of the field was also infested with rodents, recording a burrow-density of 20-35 burrows ha^{-1} (Table 2). Similar trends in infestation pattern have been reported by Tripathi *et al* (2004) and Chaudhary *et al* (2005) in moth-bean crop.

Table 1. Trap index and rodents population composition in cumin field

Period	Species of rodent trapped/100 traps/night			Total
	Mh*	Ti*	Fp*	
November, 2005	2.00	3.33	1.33	6.66
December, 2005	0.66	1.33	0.66	2.66
January, 2006	0.66	0.66	0.66	2.66
February, 2006	1.33	2.00	1.33	4.66
March, 2006	0.66	0.66	1.33	3.33
April, 2006	0.66	1.33	1.33	2.00
Per cent composition	29.03	45.16	25.81	

*Mh: Meriones hurrianae; Ti: Tatera indica; Fp: Funambulus pennanti

Table 2. Distribution pattern of live rodent-burrows in cumin fields treated with rodenticide

Mean live burrow count at different crop growth stages/ha (Nos.)						
Before crop sowing		After sowing (in crop field)				
Surrounding fallow land	Tilled fields	15 DAS	30 DAS	60 DAS	90* DAS	120 DAS
56-87	7-22	50-75	35-65	25-45	50-75	20-35

DAS - days after sowing

Damage: Damage to cumin crop during vegetative growth stage was more pronounced at the peripheral region, as burrows were mainly concentrated in this region. At a live-burrow density of 0.67/m^2, reduction in plant-stand to the tune of 9.55% was recorded. In the reference field, however rodent damage was higher (10.99%) at a live-burrow density of 0.55/m^2. At flowering stage, damage to the plant-stand was reduced to 4.9% in the treatment plots due to reduced infestation (0.30 burrow/m^2) following rodenticidal treatments. However, in the untreated/ reference plots, damage was 2.7 times higher (13.50%) than in the treated plots (Table 3).

Baiting treatments

Difethialone (0.0025%): Baiting with freshly-prepared difethialone (0.0025%) baits, at vegetative-growth as well as flowering stage, yielded significant reduction in rodent population. Rodent control success after the first pulse of treatment at vegetative growth stage was 82.40 and 80%, with live-burrow count (LBC) and census baiting (CB) methods, respectively. Follow-up treatment at flowering stage yielded an almost similar rate of success of 86.45 and 84.55% with respective methods of evaluation (Tables 4 and 5). Analysis of pooled data for both the methods revealed mean control-success of 81.20 and 85.50% after the first and second treatments respectively, with overall mean success of 83.35% (Table 6).

Bromadiolone (0.005%): Similar trend in control-success was observed in Bromadiolone treatments, also registering significant reduction between pre- and post- treatment pest population. Bromadiolone (0.005%) baiting at vegetative growth stage fetched 82.1 and 77.9% control-success as assessed by live-burrow count and census baiting methods, respectively. As with Difethialone (0.0025%), a second pulse of treatment with Bromadiolone (0.005%) at flowering stage yielded a slightly higher control-success of 85% (LBC method) and 82.50% (CB method) (Tables 4 and 5). Analysis of pooled data for both the methods revealed mean control-success of 80.0 and 83.75% after the first and second treatments respectively, with overall mean success of 81.90% (Table 6).

ANOVA between evaluation methods and treatments showed non-significant difference, indicating that efficacy of different methods remained the same. Similar trend was reported by Chaudhary *et al* (2005) and Chaudhary and Tripathi (2005) in evaluating second-generation anticoagulant rodenticides in arid agro-ecosystems. Mathur and Prakash (1984) advocated that burrow-counting method of census was more realistic in arid regions that are predominantly inhabited by *M. hurrianae*. In the present study, thus, two methods of census have been followed to draw a more accurate/valid inference. Non-significant difference between treatments also indicated that both the rodenticides were equally efficient at controlling rodent population in the fields.

Table 3. Rodent damage in cumin at different crop growth stages

Plot type	Vegetative growth stage/ Seedling stage		Flowering/ Fruit set stage	
	Burrow density/m^2	Damage (%)	Burrow density/m^2	Damage (%)
Treatment	0.67	9.55	0.30	4.90
Reference	0.55	10.99	0.65	13.50

Table 4. Bio-efficacy of second-generation anticoagulant rodenticides by live-burrow count (LBC) method in cumin crop

Treatment	Vegetative growth stage			Flowering/ Fruit set Stage		
	Pre-treatment (Nos.)	Post-treatment (Nos.)	Control (%)	Pre-treatment (Nos.)	Post-treatment (Nos.)	Control (%)
Difethialone (0.0025%)	130	23	82.40*	115	15	86.45*
Bromadiolone (0.005%)	100	18	82.10*	90	13	85.00*
Reference	150	151	NS	130	135	NS

*Significant difference between Pre- and Post- treatment census ($P<0.05$; t test);
NS: Non- significant

Table 5. Bio-efficacy of second-generation anticoagulant rodenticides by census-baiting (CB) method in cumin crop

Treatment	Vegetative growth stage			Flowering/ Fruit setting Stage		
	Pre-treatment (g) (offered)	Post-treatment (g) (consumed)	Control (%)	Pre-treatment (g) (offered)	Post-treatment (g) (consumed)	Control (%)
Difethialone (0.0025%)	500	95	80.00*	500	75	84.55*
Bromadiolone (0.005%)	500	105	77.90*	500	85	82.50*
Reference	500	475	NS	500	485	NS

*Significant difference between Pre- and Post- treatment census ($P<0.05$; t test);
NS: Non-significant

Table 6. Control of rodents by second-generation anticoagulant rodenticides estimated by burrow-count and census-baiting methods in cumin crop

Rodenticidal treatment	Control success (%)						
	Vegetative growth stage			Flowering/ Fruit set Stage			Overall success
	LBC	CB	Mean	LBC	CB	Mean	(Mean of both the stages)
Difethialone (0.0025%)	82.40	80.00	81.20	86.45	84.55	85.50	83.35
Bromadiolone (0.005%)	82.10	77.90	80.00	85.00	82.50	83.75	81.90

Table 7. Economics of rodenticide application (ha^{-1})

Expenditure head	Quantity required/ha	Cost of two applications of Bromadiolone ha^{-1} (0.005%) (Rs.)
Bait carrier @ Rs.6/kg	06 kg	36
Rodenticidal concentrate @Rs.1000/kg	120 g	120
Man-hours @ Rs.75/day	One day	75
Total cost of treatment	—	231
Amount of grain saved (Rs/ha) @ Rs.80/Kg	34 kg	2720
Net benefit (Rs/ha)	—	2489
Cost:Benefit ratio	—	1:10.8

In the present study, a second treatment with rodenticide at crop-flowering stage yielded better control and the result was similar to earlier reports by Buckle *et al* (1984), Malhi *et al* (1993) and Sheikher and Jain (1997). The present results are also in agreement with findings of Mathur *et al* (1997), Sheikher and Sood (2000), Sridhara *et al* (2000) and Tripathi *et al* (2004) who reported similar control with Bromadiolone and Difethialone in various crops/cropping systems.

Economics : In the reference, field-yield of 400kg/ha was recorded, whereas, in the treated fields, it was 442 and 434 kg ha^{-1}. in difethialone (0.0025%) and bromadiolone (0.005%) treated plots, respectively, registering an increased yield of 42 and 34 kg ha^{-1} with respective treatments. Among the two test-rodenticides, only bromadiolone is registered in India, therefore, the cost: benefit ratio could be worked out for bromadiolone only, which was 1:10.80 (Table 7).

REFERENCES

Buckle, A.P., Rowe, F.P. and Hussain, A. 1984. Field trials of Warfarin and Brodifacoum wax block baits for the control of rice field rat *Rattus argiventer* in peninsular Malaysia. *Trop. Pest Mgt.,* **30**:51-58

Chaudhary, V. and Tripathi, R.S. 2005. Bio-efficacy of second-generation anticoagulants in pearl millet-moong-moth bean cropping system in Indian arid region. *Ind. J. Pl. Prot.,* **33**:167-171

Chaudhary, V., Mohd Idris and Tripathi, R.S. 2005. Field evaluation of second generation anticoagulant rodenticides in moth bean crop. *J. Arid Leg.,* **2**: 116-119.

Malhi, C.S. Chopra, C.S. and Parshad, V.R. 1986. Poison baiting of rodents in wheat. *Ind. J. Agril. Sci.,* **55**:125-128

Mathur, R.P. and Prakash, I. 1984. Methods used in the field evaluation of anticoagulant rodenticides in India. In: *Vert. Pest Control Mgt. Materials*: Fourth Symposium. ASTM STP 817 (Ed. Kaukeinen, D.E.), Am. Soc. Testing and Material, Philadelphia, pp. 256-261

Mathur, R.P., Leirs, H. and Schockaert, E. 1997. Effectiveness of various rodent control measures in cereal crops and plantations in India. *Belg. J. Zool.,* **127**: Suppl. 1, 137-144

Sheikher, C. and Jain, S.D. 1997. Rodents in cauliflower & cabbage: population, damage & control. *Intl. J. Pest Mgt.,* **43**:63-69

Sheikher, C. and Sood, P. 2000. Acceptance and bioefficacy of Difethialone as rodenticide and its suitability in the fields. *Ind. J. Agril. Sci.,* **70**:312-316

Sree Kumar, B. 1994. Production and export of seed spices with special reference to Rajasthan. *Spic. Ind.* **7**:6-8

Sridhara, S., Ravindra Babu, T. and Ajay, P. 2000. Laboratory and field evaluation of Difethialone. All India Coordinated Research Project on Rodent Control, UAS, Bangalore, pp. 1-25

Tripathi, R.S. and Chaudhary, V. 2006. Rodent pest management in Arid Zone Crops. In: Vertebrate Pests in Agriculture - The Indian Scenario, Shankunthala Sridhara (Ed). Scientific Publisher, Jodhpur (India). pp 227-246

Tripathi, R.S., Chaudhary, V. and Mohd. Idris. 2004. Incidence of rodent pests and their management in pulse crop under arid agro-ecosystem. *Pestology,* **28**:67-70

(MS Received 7 September 2009, Revised 17 June 2010)