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Field evaluation of second generation anticoagulant rodenticides in moth bean crop

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Abstract

Three anticoagulant rodenticides viz., difethialone (0.0025%), bromadiolone (0.005%) and brodifacoum (0.005%) have been evaluated in moth crop field. These rodenticides were administered by burrow and station baiting methods for one day only at vegetative growth stage and maturity stage of crop and their efficacy was evaluated by live burrow counting and census baiting methods. Mean control success achieved as assessed by both the baiting methods was 81.43, 82.44, and 81.15 per cent with difethialone (0.0025%), bromadiolone and brodifacoum (0.005%), respectively.

Key words: *Meriones hurrianae, Tatera indica* and *Gerbillus gleadowi*, anticoagulants, live burrow count, census bating

Introduction

Moth bean (*Vigna aconitifolia* (Jacq.) Marechal) is one of the most important crops of arid regions. In western Rajasthan it is grown as kharif crop either solo or mixed with bajra and jowar. Moth alone shares 34.32% area and 32% production in this region. Arid lands supports a very high population of rodents, which cause immense losses to various production system [1]. Eighteen species of rodents have been recorded to inhabit the Indian arid zone, of that, a complex of 2-3 species are encountered in various arable cropping system of arid areas [2]. The desert rodents start their destructive activity from the time of crop sowing and continue upto harvest and later in threshing yards also. On an average, 5-10% damage is observed in rainfed crops [3]. In moth bean the rodent damage is more pronounced at seedling and maturity stages. Tripathi *et al.* (2004) reported 84.0% plant damage in moth bean at seedling stage with a burrow density of 1-2 per m^2 in peripheral region of the crop fields.

Rodenticidal baiting has been considered to be more economical and effective method of rodent control. Second generation anticoagulant rodenticides viz., difethialone, bromadiolone and brodifacoum have been evaluated against various rodent pest in laboratory and field conditions [4,5] but limited information is available on the efficacy of these second generation anticoagulant rodenticides in arid legumes. Hence, present study has been undertaken to evaluate the efficacy of three second-generation anticoagulant rodenticide in moth bean.

Material and methods

The study was carried out at village Rampura, distt. Jodhpur. The area is well irrigated (rabi) and rainfed (kharif) with loose sandy soil. In Kharif, which is mainly rainfed, major crops grown were pearl millet, moong, moth, guar, groundnut, sesame etc. An area of about 4 ha having solo moth bean and fairly good infestation of rodent pests with no previous record of rodenticidal treatment for at least one year was selected for the present study. The field trials were laid down following Randomised Block Design. Accordingly the area was divided into two blocks of 2 ha each which was further divided into 3 plots of 0.5 ha each. The gap between two plots and at border was kept 25m to avoid intermixing of pest population. In each block a plot of same size, which was well separated by railway track of about 200 m from the treatment plot was kept as reference plot.

Test rodenticide and baiting methods: Bromadiolone (0.005%) and brodifacoum (0.005%) ready to use wax block/pellets were used to evaluate their efficacy in moth field, whereas, fresh cereal bait of difethialone (0.0025%) was utlised for the trials. Two bating methods, viz., burrow and station baiting method [6] was adopted for laying the test poison baits. Three treatments of the test anticoagulant rodenticides namely difethialone

(0.0025%), bromadiolone (0.005%) and brodifacoum (0.005%) were baited randomly in the treatment plots. Prior to poison baiting the burrows were plugged and on next day the reopened (live) burrows were baited with 10-15 g poison baits of all the three test rodenticides. Similarly 50-100 g test baits were placed in each bait stations. On an average, 20-25 bait stations were laid for each treatment. Poison treatment was given for one day only.

Method for assessing the efficacy: Field Efficacy of the three rodenticideds was assessed by following two methods viz., live burrow counting (LBC) and census baiting (CB) method simultaneously.

For LBC method all the burrow openings in the experimental plot were plugged late in the evening. Reopened burrows were counted early in morning. For post treatment observations the burrows were replugged and the reopened ones were counted again. The reduction in rodent activity, calculated on the basis of pre and post treatment live burrow count was considered as control success. Similarly for CB method plain bajra grains were provided in bait stations for three days before and after treatment. Pre and post consumption was recorded and reduction in the activity of rodents was calculated as control success. The efficacy of rodenticides was quantified in terms of percentage using the following formula [7].

Per cent control success = (1-[(T2xC1)/(T1xC2)]), where

T1 – Pre treatment population of rodent pests in treatment plots

T2 – Post treatment population of rodent pests in treatment plots

C1 – pre treatment population of rodent pests in control plots

C2 – Post treatment population of rodent pests in control plots

Rodenticidal treatments were given at two different stages of crop growth viz., vegetative growth stage i.e. 30 days after sowing and at maturity stage i.e. 60 days after sowing. The post treatment census were made 10 days after treatment because these rodenticides yield maximum mortality between 7-10 days.

Results and discussion

Species composition and magnitude of infestation: For knowing the species composition three-night trapping were done by laying Sherman live traps in the study and adjoining areas. The predominant species were *Meriones hurrianae* followed by *Tatera indica* in the sandy plain and *Gerbillus gleadowi* was encountered on the nearby sandy hummocks only. *Funambulus pennanti* was also seen frequently on the trees grown in the immediate vicinity of crop fields. Magnitude of rodent infestation was 3.35-4.84 and 2.75-4.34 burrows/10x10m^2 areas at vegetative growth stages and maturity stage respectively.

The findings of the present field trials with different test rodenticides are discussed as under:

Efficacy of rodenticides:

(a) Difethialone (0.0025%): In Difethialone (0.0025%) treated plots a significant ($P < 0.05$, 't' test) alteration in pre and post treatment population was observed, whereas, it was non significant in control plot. Control success at vegetative growth stage of crop after treatment as assessed by Live Burrow Count and Census Baiting method was 81.87 and 80.25% respectively (Table 1&2). The average success by both the methods was 81.06% (Table 3). Second treatment at maturity stage of crop yielded slightly higher control success of 82.39 and 81.21% as assessed by both the respective census methods (Table 1&2) with an average success of 81.80% (Table 3). Overall success with this rodenticide calculated on the basis of both the methods and stages of treatment was 81.43 per cent.

(b) Bromadiolone (0.005%): A significant difference was observed between pre and post treatment census of rodent population in bromadiolone (0.005%) treated plots, on other hand in control plot it was non significant. The action of bromadiolone (0.005%) at vegetative growth stage achieved 81.40 and 81.82 per cent control success by live burrow count and census baiting methods, respectively (Table 1 & 2). The average control success assessed by both the methods when evaluated after treatment at vegetative growth stage was 81.61 per cent (Table 3). Like difethialone (0.0025%) second pulse of treatment of bromadio-lone (0.005%) at maturity stage also yielded higher control success of 83.84 and 82.71 per cent by live burrow count and census baiting methods, respectively (Table 1 & 2) with an average success of 83.27% at maturity stage (Table 3). Overall mean control success irrespective of crop stage and census method was maximum (82.44%) with bromadiolone treatment.

(c) Brodifacoum (0.005%): This treatment too yielded a significant reduction in rodent population. A control success of 79.85 and 80.69% was recorded when assessed by Live Burrow Count and Census Baiting methods, respectively (Table 1 & 2) with an average success 80.27 (Table 3) at vegetative

growth stage. Second treatment at maturity stage yielded a control success 82.0% by both the assessment methods. Pooled mean data for success under both the crop stages and assessment methods recorded an overall success of 81.15 per cent with brodifacoum (0.005%) treatment (Table 3).

Table 1. Bio-efficacy of second-generation anticoagulant rodenticides following live burrow count method in moth crop

S. No.	Rodenticides treatments	Vegetative growth stage			Maturity stage		
		Pre-treatment (Nos)	*Post-treatment (Nos)*	*Control success (%)*	*Pre-treatment (Nos)*	*Post-treatment (Nos)*	*Control success (%)*
1.	Difethialone (0.0025%)	417.00	84.00	81.87*	367.00	67.00	82.39*
2.	Bromadiolone (0.005%)	484.00	100.00	81.40*	400.00	67.00	83.84*
3.	Brodifacoum (0.005%)	335.00	75.00	79.85*	275.00	51.00	82.11*
4.	Reference	450.00	500.00	-Ns	434.00	450.00	-Ns

*- Significant difference between pre and post treatment census ($p<0.05$; 't' test)

Ns- No significant difference between pre and post treatment census ($p<0.05$; 't' test)

Table 2. Bio-efficacy of second-generation anticoagulant rodenticides following census-bating method in moth crop

S. No.	Rodenticides treatments	Vegetative growth stage			Maturity stage		
		Pre-treatment (g)	*Post-treatment (g)*	*Control success (%)*	*Pre-treatment (g)*	*Post-treatment (g)*	*Control success (%)*
1.	Difethialone (0.0025%)	271.00	55	80.25*	217.33	40.00	81.21*
2.	Bromadiolone (0.005%)	303.34	56.67	81.82*	206.67	51.66	82.71*
3.	Brodifacoum (0.005%)	226.66	45.00	80.69*	198.34	35.00	81.98*
4.	Reference	236.67	243.34	-Ns	246.67	241.60	-Ns

*- Significant difference between pre and post treatment census ($p<0.05$; 't' test)

Ns- No significant difference between pre and post treatment census ($p<0.05$; 't' test)

Analysis of variance (ANOVA) between treatment and method showed non-significant variation in control success indicating that both the methods (LBC & BC) are yielding similar results and hence any of these methods can be utlised for such studies. Similar results have also been reported [8] with field evaluation of brodifacoum, chlorophacenon and Coumatetralyl in arid rangelands. Similarly all the three anticoagulant rodenticides evaluated in moth crop fields yielded over 80% of control success with no significant variation among treatments. This evidently proves that all the three rodenticides are equally potent in tackling the rodent problem in the fields. Difethialone treatment showed an edge because of similar effectiveness at lower concentration (0.0025%) as compared to other treatments of the same generation, which are recommended at 0.005% concentration in baits.

Table 3. Control success of second-generation anticoagulant rodenticides as estimated by live burrow count and census-bating method in moth crop

S. No.	Rodenticidal treatments	Vegetative growth stage			Maturity stage			Overall success (%) (Mean of both the stage)
		Control Success (%)			*Control Success (%)*			
		LBC method	*CB method*	*Mean*	*LBC method*	*CB method*	*Mean*	
1.	Difethialone (0.0025%)	81.87	80.25	81.06	82.39	81.21	81.80	81.43
2.	Bromadiolone (0.005%)	81.40	81.82	81.61	83.84	82.71	83.27	82.44
3.	Brodifacoum (0.005%)	79.85	80.69	80.27	82.11	81.98	82.04	81.15

Burrow baiting with brodifacoum (0.0025%) and bromadiolone (0.005%) in arid pulses have yielded 87.74 and 84.97 per cent control success [3]. It was further observed in the same study that treatment of zinc phosphide (2.0%) followed by bromadiolone (0.005%) provides sustained protection of crop from rodent attack. In other field crops also bromadiolone and brodifacoum at 0.005% achieved 62-100% rodent control success [4,8]. Similarly difethialone (0.0025%) yielded upto 76.96% rodent control success in cereal, vegetable and fruit crops in Himachal Pradesh [9]. Second treatment at crop maturity stage yielding higher control success in the present study was also reported by several workers [10-12]. The present findings are in good agreement with the findings of earlier workers with difethialone (0.0025%) [13]; bromadiolone (0.005%) [5,14] and brodifacoum (0.005%) [4,8] in various crops.

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