

SHORT COMMUNICATION

Laboratory Evaluation of Dibenz (b,f)-1,4-Oxazepine for the Protection of Nylon Tapes against Rodents Attack

M.J. Mendki, Shri Prakash, P.K. Gutch, R.C. Malhotra and K.M. Rao
Defence Research & Development Establishment, Gwalior - 474 002

and

Jagat Singh and I. Hussain
Aerial Delivery Research & Development Establishment, Agra - 282 001

ABSTRACT

The efficacy of dibenz (b,f)-1,4-oxazepine (CR), a potent sensory irritant and deltamethrin a well-known insecticide, in providing protection to the multi-element nylon tapes, used as aircraft arresters at airports have been evaluated. The results obtained indicate that 5 per cent CR-admixed UV resistant nylon tapes got adequate protection against attacks from wild type laboratory bred *Rattus rattus* for up to 160 days. CR treatment was found to be water wash resistant against 7, 30 and 60 days protection offered by 3, 4 and 5 per cent deltamethrin, respectively.

1 INTRODUCTION

Rodents are not only carriers of diseases but also cause enormous damage to agricultural crops and stores¹⁻⁶. Of late, rodents have been reported to inflict severe damage to the multi-element nylon tapes used as aircraft arresters in airfields. Though, several methods have been used for the control of rodents, depending upon the situation⁷⁻⁹, no information is available on the way these multi-element nets can be protected against rodents attack. These multi-element nets are used to stop an aircraft from overshooting the runway in emergency.

Dibenz (b,f)-1,4-oxazepine (CR) has been reported as a potent non-toxic sensory irritant and a riot control agent¹⁰⁻¹². Earlier studies at this Establishment using 1-10 per cent CR had shown that CR exhibits irritant property at 5 per cent concentration¹². Keeping

its high irritancy in view, the present study was undertaken to evaluate its potential to provide protection to CR-impregnated nylon tapes against rodents attack. The efficiency of CR was compared with that of deltamethrin, a potent non-toxic insecticide with high irritant property.

2. MATERIALS & METHODS

2.1 Test Chemicals

CR was synthesised in the laboratory from o-chlorobenzaldehyde and orthoaminophenol by condensation followed by ring closure. CR is a yellow crystalline solid; m.p. 74 °C, and purity 99.5 per cent. The compound is very stable. Deltamethrin (technical grade) was obtained from M/s AgrEvo Schering Hoechst, Mumbai. Deltamethrin is a white solid; m.p. 101°C, and purity 98 per cent¹³.

2.2 Test Animals

Laboratory bred wild type commensal rats (*Rattus rattus*) were drawn from the colony maintained in the Establishment. Rats in weight range 150-200 g were used in the study. Animal feed obtained from M/s Amrut Feeds, Pune, was provided *ad libitum*, water was also provided *ad libitum*.

2.3 UV Treatment of Nylon Tapes

A method has been developed for UV treatment of nylon tapes using the following ingredients:

Rectified spirit	100	parts
Synpol B-30 (butyral resin)	10	parts
Carbon black (ISAF/N220)	5	parts
Butyl resinoleate	10	parts
Dynasylon (memo)	0.05	part

Synpol B-30 (butyral resin) (10 parts) was added to 50 parts of rectified spirit. The mixture was stirred gradually to get a homogeneous solution. To the solution thus obtained, 5 parts of carbon black and 10 parts of butyl resinoleate were added. After allowing the suspension to stand for 48 hr, the rest of the rectified spirit (50 parts) was added.

CR (5 per cent) and deltamethrin at concentrations of 3, 4 and 5 per cent were added to the solution separately. Dynasylon (0.05 part) was added to the solution before treatment. Strips (8 cm × 3 cm) were cut from nylon tapes and treated with the UV treatment solution. The strips were passed through rollers to squeeze out the surplus solution. Curing was done at 140 °C for 6 min.

To ascertain the waterwash resistance of the nylon strips, they were washed under accelerated conditions for 6 hr under tap water and allowed to remain overnight in a water filled container. After washing, the strips were dried at room temperature. Control strips were treated in the same manner without CR or deltamethrin.

2.4 Evaluation of UV Resistant Nylon Tapes against Rodents Attack

Nylon strips (4 Nos. one at each corner), treated with CR (5 per cent) and deltamethrin (3, 4 and 5 per cent concentration) were tied vertically in

separate wire mesh rodent cages. Control nylon strips were also tied simultaneously. Six wild type rats (*Rattus rattus*) were released in these cages and the extent of protection attained by the strips was observed visually everyday to assess their rodent proofness. The experiment was terminated when visual damage was observed and the data were analysed.

3. RESULTS & DISCUSSION

Rodenticides have been effectively used for the control of rodents. However, the application of rodenticides or other conventional methods of rodent control may neither be economical nor feasible for the protection of nylon tapes.

A multi-element net made of UV resistant treated nylon tapes has been developed. The net is 58 m in length and 4.5 m in width. It has got multiple element comprising 90 horizontal and 570 vertical strips made of nylon tapes used as aircraft arresters. However, these tapes are vulnerable to rodent attack, although various sensory irritants, such as o-chlorobenzylidene malanonitrile (CS) and 1-chloroacetophenone (CN), have been reported in literature¹²⁻¹⁴. The authors have developed the sensory irritant CR as a potent riot control agent¹⁰⁻¹². This agent with low toxicity and high irritant property is being used by various police and paramilitary organisations. CR creates a highly unpleasant taste and burning sensation in the mouth accompanied by profuse salivation, but no toxicological hazards are associated with it. Data on protection attained by UV resistant nylon strips treated with deltamethrin (concentration range 3-5 per cent) and CR (5 per cent) are given in Table 1. It is seen that the percentage loss in weight of UV resistant strips is directly related to the protection from rodent damage achieved. The concentration-dependent loss in weight of UV resistant strips vis-a-vis protection in respect of deltamethrin was observed. Deltamethrin-treated UV resistant strips offered protection for 7, 30 and 60 days following treatment with 3, 4 and 5 per cent concentration of deltamethrin, respectively (Table 1).

CR-treated nylon strips showed the minimum weight loss of 6 per cent up to 160 days of exposure.

Table Protection against damage by commensal rat (*Rattus rattus*) attained by UV resistant-treated nylon strips on treatment with irritants

	Control strips	Deltamethrin-treated			CR-treated 5%
		3%	4%	5%	
Wt. of strips before UV treatment (g)	6.115 ± 0.060	6.062 ± 0.020	6.080 ± 0.010	6.069 ± 0.040	6.084 ± 0.040
Wt. of treated strip after UV and irritant treatment (g)	6.786 ± 0.050	6.810 ± 0.050	6.812 ± 0.010	6.857 ± 0.060	6.921 ± 0.020
Total quantity laid upon the strip (mg/cm ²)	27.90	31.10	30.50	32.80	34.80
Wt. of treated strips after exposure (g)	4.07 ± 0.52	5.25 ± 0.76	5.44 ± 0.64	5.83 ± 0.42	6.52 ± 0.17
Per cent Wt. loss	40.00	23.00	20.00	16.00	6.00
Protection against rodent damage (days)	0.00	7.00	30.00	60.00	160.00

Values are mean ± SE, n (number of rats) = 4

Thus protection from damage lasted up to that period.

ACKNOWLEDGEMENT

The authors are thankful to Dr R.V. Swamy, Director, Defence Research & Development Establishment, Gwalior, for his keen interest in the study and the encouragement provided by him.

REFERENCES

- Prakash, I. Rodent pest management. CRC Press Inc, Boca Raton, 1988.
- Buckle, A.P. & Smith, R.H. Rodent pests and their control. CAB International, U.K., 1994.
- Hernandez, A. & Drummond, D.C. A study of rodent damage to food in some cuban warehouses and the cost of preventing it. *J. Stored Prod. Res.*, 1984, **20** (2), 83-86.
- Acha, P.N. & Szyfres, B. Zoonoses and communicable diseases common to man and animals, PAHO Science Publication No. 354, Washington DC., 1980.
- World Health Organisation. Human plague in 1989. *Weekly Epidemiol. Rec.*, 1990 a, **42**, 321-23.
- World Health Organisation. Chagas disease-frequency and geographical distribution. *Weekly Epidemiol. Rec.*, 1990b, **65**, 257-69.
- Sinclair, A.R.E. Population regulation in animals. In Ecological concepts, edited by J.M. Cherrett. Blackwell, Oxford, 1989. pp. 197-241.
- Gutteridge, N.J.A. Chemicals in rodent control. *Chem. Soc. Rev.*, 1972, **1**, 381-409.
- Prakash, I. Bait shyness and poison aversion. In Rodent pest management, edited by I. Prakash. CRC Press, Boca Raton 1988. pp. 321-329.
- Hussain, K.; Kumar, P. & Malhotra, R.C. A comparative study of biochemical changes induced by inhalation of aerosol of o-chloroacetophenone and dibenz (b,f)-1,4-oxazepine in rats. *Ind. J. Med. Res.*, 1991, **94** B, 76-79.
- Kumar, P.; Vijayraghavan, R.; Pant, S.C.; Sachan, A.S. & Malhotra, R.C. Effect of inhaled aerosol of 1-chloroacetophenone (CN) and dibenz (b,f)-1,4-oxazepine (CR) on lung mechanics and pulmonary surfactants in rats. *Hum. Exptl. Toxicol.*, 1995, **14**, 40-49.
- Malhotra, R.C. & Kumar, P. Chemistry and toxicity of tear gases. *Def. Sci. J.*, 1987, **37**, 281-96.
- Lhoste, J. Deltamethrin Monograph. Roussel-Uclaf, 1982.
- Corson, B.B. & Stoughton, R.W. Reactions of alpha, beta-unsaturated dinitriles. *J. Am. Chem. Soc.*, 1928, **50**, 2825-837.
- Schaefer, J.P. & Sonneberg, F. Chlorination of ketones with selenium oxychloride. *J. Org. Chem.*, 1963, **28**, 1128.

Contributors



Mr MJ Mendki obtained his MSc (Zoology) from North Maharashtra University in 1997. He joined DRDO at the Defence Research & Development Establishment (DRDE), Gwalior, in 1990. His areas of research include: medical entomology, insect toxicology, neuroanatomy, electrophysiology and pheromones. He has published several papers in national/international journals. He has one patent to his credit.



Dr Shri Prakash obtained his PhD from Jiwaji University, Gwalior, in 1984. He joined DRDO at DRDE in 1971. His areas of research include: medical entomology, insect toxicology, neuroanatomy, electrophysiology and pheromones. He has published 40 papers in national/international journals and also has few patents to his credit.



Dr PK Gutch received his PhD (Organic Chemistry) from Jiwaji University, Gwalior, in 1997. He joined DRDO at DRDE, Gwalior, in 1984. His areas of research include: process development, structure-activity relationship of various tear gas compounds, such as CR, CS and CN related to defence applications. At present, he is working on polymer synthesis. He has published 12 papers in national/international journals and has one patent to his credit.



Dr RC Malhotra obtained his PhD (Organic Chemistry) from Jiwaji University, Gwalior. He joined DRDE, Gwalior, in 1969. Presently, he is working on the synthesis, chemical analysis, process development, destruction and decontamination of lethal, non-lethal compounds and semiochemicals. He has published 35 papers in national/international journals. He was honoured with the *DRDO Scientist of the Year Award* (1996) in basic sciences for its outstanding contributions.



Mr KM Rao joined DRDO in 1968. Presently, he is working as Associate Director and heading Entomology Division at DRDE, Gwalior. He has published 70 papers in national/international journals and has 12 patents to his credit. He is the recipient of *VASVIK Industrial Research Award*.