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# RESEARCH TOWARDS THE DEVELOPMENT OF MORE EFFECTIVE RODENTICIDES AND MORE EFFICIENT METHODS FOR THEIR APPLICATION

by

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## 1. The Development of more Effective Rodenticides and more Efficient Methods for their Application

There is always a need for new and improved rodenticides and techniques for using them in the control of field and urban rodents. We need more effective rodenticides and more efficient methodology. Rodent control operations also need to be safer and more selective for the target species. No rodent control programme can be improved unless it is well supported directly or co-operatively with sound basic and applied research. To develop ways of using existing rodenticides more effectively and of applying them more efficiently, it is essential that every national and local government have one or more individuals devoting full time to testing new materials and methods, and serving as a consultant or assistant to the control operators.

Even though research aimed at finding more effective and safer rodenticides and more efficient ways of applying them is grossly under-financed in all countries and in the United Nations, many studies are currently underway throughout the world. Since the cost of getting a new rodenticide registered in the U.S.A. and other countries is often in excess of the market value, many chemical companies are not interested in registering existing potential rodenticides, especially if the product would also be competing with another one of their own compounds. But, in spite of these handicaps, a number of potential rodenticides are currently being investigated in different countries by governments, universities and other organizations.

Research is also underway investigating potential rodent chemosterilants. During the Seminar we can discuss some of these chemosterilants and other rodenticides new under investigation. Certainly there is a place for safer, more selective and more effective rodenticides. The most promising potential acute rodenticide for rat control that the writer and colleagues have done research on in the U.S.A. and South Korea is an experimental compound coded RH-787. It is sufficiently selective for commensal rodents and safe enough that ready-to-use baits can be used by the general public.

Much more research on the rodent species involved is still needed

regarding their general biology and ecology, taxonomy, population dynamics, social structure and behaviour related to smell, taste and vision. Little information is available on the relationship of cost of control to the benefits derived. The amount of rodent damage to goods, foods and agricultural crops, and the public health hazards are not well established anywhere in the world, but it is most obvious that this loss and these problems are economically significant in most situations where high densities of rodent populations persist. Damage is difficult to measure accurately, and especially hard to carry out on a large scale. Rats and many other species of rodents are nocturnal, hence difficult to observe while they are doing damage.

In developing countries there is often an increased hazard to the use of acute rodenticides due to illiteracy, hunger and dense crowding of people. Where poverty is widespread, it is difficult to get people to spend the resources and time required to tend bait stations, even though not much training is required to use the anticoagulant baits.

## 2. Rodent Control Research Needs

The entire Seminar could profitably be devoted to a discussion of research needs. Some subject areas have been listed that need more research. This list is far from all-inclusive and is merely designed to stimulate the reader to think about these and other important areas in rodent control where we need more information so that we can have a good discussion during the Seminar. These are in addition to the needs that have already been discussed, and some also represent certain aspects of rodent control that often are not considered.

A. Ideal rodenticide

B. Protecting non-target species

C. Reducing secondary poisoning hazards

D. Bait and rodenticide shyness - After rodents consume a sub-lethal amount (dose) of an acute rodenticide, they usually learn first to shy from the bait material instead of the rodenticide. Upon repeated exposure thay may then also learn to shy from the toxicant. But, with some species and certain rodenticides, the rodents may also develop a toxicant shyness after one exposure. The quality of the rodenticide used

is very important, for impurities in the rodenticide may be the basic cause of developing shyness. The way baits are formulated and used can often be directly correlated with the degree of shyness that develops.

E. Aversive conditioning and associative memory - One way to prevent rodents from digging up planted seeds is to treat the seeds with a chemical that provides a physiologically unpleasant sensation when consumed by a rodent so that a kind of bait shyness develops. The rodent will often, at least for a time, refuse that type of seed whether or not is has been treated, once they have eaten some that made them sick. It appears that once rodents have learned not to eat a poisoned bait they may remember this experience for a long period in their lives, but with increased time the degree of aversion diminishes.

F. Imprinting bait shyness on offspring - When a rodent bait is consistently present, bait-shy adults are able to train most of their offspring also to be shy of that kind of bait. Imitation of the parent's food habits by the offspring may save the young from consuming toxic baits if the parents reject them.

G. Degree of population reduction necessary - It seldom is known just how low a particular rodent population must be reduced before the operation can be considered effective, for inadequate control may merely increase the vigor and reproductive success of the survivors. Local eradication is usually the goal with rats and house mice, but with many field rodents the success or failure of a control operation, where the density is reduced to a tolerable level, is often the difference of but a few individuals per unit area.

H. Local eradication - Local eradication does not imply species extermination. Most local eradication is the result of habitat modifications, not due to intentional control efforts.

I. Mixture of bait materials - Little research has been done to measure the effects of using a mixture of different bait materials, such as different kinds of cereals, when using an acute rodenticide to control either field or urban rodents. Such a mixture may greatly reduce the chance of individuals surviving because they have become bait-shy.

J. Odour, taste and attractants - More sophisticated research is needed

in this area to assist rodent control. If rodents become conditioned to associate an odour with a palatable bait material, the addition of that odour to baits would then make it easier for the animals to locate subsequent baits that also contained that odour. When the baits are to be broadcast, the presence of the odour would greatly reduce the amount of bait that must be applied.

K. Single baits made lethal - If each poison bait kernel or pellet contained a lethal dose, fewer baits and less total toxicant may be needed. Often this cannot be done because with too much poison on too small a bait, rodenticide shyness may develop. Pelleted baits may overcome this problem.

L. Pre-baiting - Few studies have been made to evaluate carefully the effects of pre-baiting or free-feeding with a non-toxic bait prior to a poison treatment, so seldom do we know the true economics and merits of the pre-baiting approach.

M. Dilution baiting - Bait acceptance can be increased and the total amount of toxicant used reduced by combining pre-baiting with single baits made lethal. Bait acceptance may be increased because many individuals will by chance consume a safe bait before finding and consuming a toxic one. If different kinds of bait and poison are used simultaneously in dilution baiting, and they are scattered sparsely, there may be less chance of bait or poison shyness developing.

N. Slow kill versus quick kill - The relative merits of slow-acting acute rodenticides and slow kill resulting from sparsely scattered baits, which are each lethal, are important factors to consider when formulating baits.

O. Durable versus degredable baits - Here the problems of environmental contamination associated with long-lasting baits must be compared with the fact that far less toxicant may be needed if the baits are designed to last for longer periods and are attractive only to the species being controlled. Small amounts of a durable bait could be extremely effective as a follow-up treatment. Fewer treatments are needed with durable baits, and they are more weather-resistant. Durable baits are needed for working into the soil and environments like sewers.

P. Bait size and texture - A small amount of data is available regarding the relative merits of different bait sizes (whole kernels, cracked kernels, meals, pellets of various sizes and texture). Factors involved are the type of rodenticide to be used, environmental hazards and how rodents locate baits for the first time.

Q. Amount of bait to use - Considerable field experience is needed since research has not established good guidelines. Some rodents are greedy and consume far more than is necessary, while others eat but a fraction of their normal intake if the poison bait acts quickly, and feeding ceases after little more than a lethal dose has been consumed.

R. Rodenticide concentration - The precise amount of various rodenticides to use in formulations with different kinds of bait cannot be evaluated easily, without conducting extensive field tests. Historically, most rodenticides initially were used at strengths that were stronger than really needed. When a bait formulation provides the desired results, few people have or take the time to field-test a weaker concentration.

S. Broadcasting and aerial baiting - Studies are needed to determine, with different species of field rodents, whether it is better to scatter the bait instead of putting it in or near burrows. Much evidence indicates that spot treatment by aircraft can be cheaper, more effective and environmentally safer than ground application for some species of field rodents such as ground squirrels.

T. Chemical repellents - Research for better repellents is greatly needed, but this approach may be too costly and too restrictive for wide rodent control use.

U. Frightening devices - air, sound, lights and electric shock - Much more research is needed to evaluate various frightening devices. We have found that air flow can be a barrier to rats. Our research shows that ultrasound is not very effective. There are few data as to the benefits of using lights to discourage nocturnal rodents. Electric shock can be effective, if there is no possible way for the rodents to learn to go under or over the charged wires.

V. Predation - It is always advisable to encourage natural enemies, but it must be recognized that predators usually do not keep rodent pests

at low enough densities, hence the need for artificial controls. If rats are not being controlled with rodenticides, then cats may keep a rat population from increasing more. However, it is usually cheaper and more effective to poison rats then it is to buy cat food. For predators to be living off a single rodent species, there must be many rodents present.

W. Environmental manipulation - The suitability of the habitat, that is the degree of food and cover provided by the environmental conditions, is what determines whether or not rodents will be present and in what numbers up to the carrying capacity. Much more ecological research is needed better to understand the environmental regulatory factors.

X. Sanitation - More data are needed to show the economic value of reducing rodent populations by various sanitary practices in cities and agricultural communities.

Y. Rodent proofing or exclusion - The best and only permanent way to control rodents in houses and warehouses, when economically feasible, is to deny them access by building them out. Co-operative studies by architects and biologists are needed to determine the most suitable kind and quality of building materials to be used in different countries for various types of structures.

## SELECTED REFERENCES

There is no point in listing an extensive bibliography on rodent control here. An extensive review of pertinent references relating to rodent control appeared last year:

Brooks, J.E. 1973. A review of commensal rodents and their control. Critical Reviews in Environmental Control, Vol.3, issue 4, 405-453. For copies write to Mr. Joe E. Brooks, New York State Department of Health, Bureau of Rodent Control, Albany, New York 12200, U.S.A.

Several excellent volumes of a Bibliography on Rodent Pest Biology and Control have also recently been published by FAO/WHO.

The following references were cited in this report:

Bentley, E.W.: Review of currently used anticoagulants, and Gratz, N.G.: A critical review of the currently used acute rodenticides. Both in Seminar on Rodents and Rodent Ectoparasites, October 24, 1966. WHO/VC/66, Geneva, 220 pp., 1966.

Howard, W.E. and R.E. Marsh, 1974. Rat control manual. Pest Control Magazine, Vol.42, No.7, 18 pp. For copies write to authors at the Division of Wildlife and Fisheries Biology, University of California, Davis, California 95616, U.S.A.

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