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ENVIRONMENTAL HEALTH ABSTRACTS & BIBLIOGRAPHY

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focus:
RODENT CONTROL

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE - PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL, ATLANTA, GEORGIA 30333

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Foreword

Environmental Health Abstracts & Bibliography presents a survey of recently published literature in the field. Effort is made to keep the abstracts as current as possible and sufficiently informative to enable the reader to decide whether the original article would be of interest to him or her. For the benefit of the reader, where possible the address of the first author is included with each abstract. Future issues will be devoted to various other environmental health topics.

In compiling these abstracts we utilize the National Library of Medicine's interactive retrieval service, MEDLARS II, along with BIOLOGICAL ABSTRACTS, the BIBLIOGRAPHY OF AGRICULTURE, CHEMICAL ABSTRACTS, and SCISEARCH. Under these systems, both foreign and domestic biomedical periodicals are searched for material dealing with or related to environmental health. We also utilize the libraries of Emory University, Georgia Institute of Technology, Center for Disease Control, and other federal agencies.

Individuals desiring to be placed on the mailing key to receive *Environmental Health Abstracts & Bibliography* as published should write to the Center for Disease Control, Attention: Environmental Health Services Division, Bureau of State Services, Atlanta, Georgia 30333.

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Contents

A Three-Year History of the Use of the Genetically Sterile Male Norway Rat in the Control of Wild Rat Populations

A.J. Stanley, L.G. Gumbreck, J.E. Allison, and H.F. Landreth–Departments of Physiology and Biophysics and Anatomical Sciences, University of Oklahoma Health Sciences Center and Oklahoma City Zoo, Oklahoma City, OK 73190. TEXAS REPORTS ON BIOLOGY AND MEDICINE 32(2): 596, 1974.

From author's abstract: In 1967 the discovery of the genetically sterile male rat was first reported by the authors. Its use as a control measure for wild Norway rat populations was also proposed at that time. Cage and pen studies and an open field trial on an egg farm near Oklahoma City have now been completed, testing the efficacy of this method of rat control. Landreth and associates, beginning February 1, 1971, using a series of metal outdoor pens 50 by 50 feet, found that the reduction of population potential was proportional to the ratio of sterile to normal males when the number of females placed in each pen was always equal to the sum of both sterile and normal males. These experiments were repeated in indoor pens 25 by 25 feet with light and temperature controlled. The final reduction in population potential for the outdoor experiments was 73.5 percent, and 75.8 percent for the indoor experiments. In these experiments the results are highly significant. Several observations can now be made as to the future use of this method: 1) Laboratory bred sterile males should be "feralized" before being released into a strange environment; 2) more highly aggressive males are being bred to attack and perhaps kill wild males on contact in the release area; 3) warfarin resistance is being introduced into the sterile male line.

Studies on the Effectiveness of Rodenticides. I. The Comparative Rodenticidal Efficacy of Several Anticoagulants (Japanese)

I. Tanaka, Y. Ito, and H. Shigeta–Department of Environmental Biology, Japan Environmental Sanitation Center, Kawasaki, Japan. EISEI DOBUTSU 27(4): 347-53, 1976.

English summary: The comparative rodenticidal effectiveness of five anticoagulants was examined. The acute toxicities obtained were low in mice for both the coumarin derivatives and indandiones, whereas those shown in rats were remarkably high. In the subacute testing, the indandiones were more potent than coumarins. Also, **coumatetralyl** given to mice was least effective of the five chemicals tested. However, when given to rats, it showed nearly the same effectiveness as did the indandiones. The coumarin derivatives failed to attain 50 percent mortality at lower dosages in the subacute test, which may indicate a threshold concentration for these chemicals. When the rodenticides were given to rats and mice as baits, high mortalities were obtained but the differences in the activities of the chemicals were not observed.

A Review of Rodent Control Programs in New York State

J.E. Brooks–Bureau of Rodent Control, New York State Department of Health, Albany, NY 12237. VERTEBRATE PEST CONFERENCE. PROCEEDINGS 6:132-41.

Author's abstract: The history of rodent control programs in New York State is reviewed, beginning with state-funded efforts in August 1967. In 1969, Federal rodent control grant funds were used to establish four Model Cities programs. At its peak in 1970, programs were active in 18 counties, 8 cities and villages, and in 6 Model Cities areas. The program encompasses all the major metropolitan areas of the state, serving some nine million persons.

As part of the state program, the Rodent Control Evaluation Laboratory was established to investigate chemosterilants as a means of rodent control and to develop knowledge of pest rodent biology. Since then, the investigations program has turned to the problem of rodent resistance to anticoagulant rodenticides both in New York and other states in the eastern United States.

Initial rat infestations, which ran 24.4 percent statewide in 1969, have been decreased 84 percent by late 1973. Similarly, in the same time period, unapproved refuse storage deficiencies were decreased by 55.6 percent and exposed gar-

bage conditions declined 44.7 percent. Rat bites showed a 40 percent decrease during these same years. By all measures, then, the program has been a success.

Most programs have relied heavily upon anticoagulant rodenticides in the chemical control of rodent populations. Zinc phosphide, red squill, and norbormide are also used. Harborage removal and environmental improvement are stressed through active cleanups and educational efforts. During the 4-year period, 1969-1972, some 177,000 tons of rat harborage were removed from 66,000 premises in the state.

Trapping: A Continuous Integral Part of a Rodent Control Program

H.R. Schuyler and R.F. Sun, Jr.–Plant Production and Protection Division, Food and Agriculture Organization of the United Nations, Rome, Italy. VERTEBRATE PEST CONFERENCE. PROCEEDINGS 6:150-60.

Author's abstract: Trapping is usually considered a rodent control technique of minor importance. Due to the economic situation in the Dumaguete, Phillipines program from which this report is drawn, regular trapping was a biological necessity. Four species of rodents and a shrew [65.9% of the total being *Rattus norvegicus*] were of concern. A continuing daily trapping program was developed from a field study of trap bait acceptability. [The acceptability of various baits is described.] Trap baits were reused every 23 days. Alternate baits were selected. Trap usage techniques were designed to optimize the results. Trap-bait shyness and trap shyness effects were observed but were not a major problem.

A Regional Approach to Rodent Control in the San Francisco Bay Area

E.W. Mortenson and G.L. Rotramel–California Department of Health, Vector Control Section, 2151 Berkeley Way, Berkeley, CA 94704. PROCEEDINGS OF THE VERTEBRATE PEST CONFERENCE 7: 235-41, 1976.

Authors' abstract: A federally funded rat control project [through Section 314e of Public Law 89-749 from the Department of Health, Education, and Welfare] is being conducted by the Vector Control Section, California State Department of Health in cooperation with local health agencies in the San Francisco Bay Area. Four community demonstration areas were selected in urban poverty areas in the region. The objective of each demonstration program is to reduce the rat infestation to a level that will not have significant adverse health or economic effect. Environmental improvement and community participation are emphasized. Concurrent studies are being conducted to determine the status of anticoagulant resistance, the occurrence of rodent-borne diseases, and the significance of rat infestations in sewer systems. The information gained from the project will provide improved methods and management criteria for rat control programs in the San Francisco Bay Area and other areas of the State with similar rodent problems.

Rat Control with an Anticoagulant–Drat

K. Singh and T.P. Ojha–Harvest and Postharvest Technology (ICAR), Scheme Agricultural Engineering Department, Indian Institute of Technology, Kharagpur-721302, West Bengal, India. INTERNATIONAL PEST CONTROL 18(3): 10, May-June 1976.

In India, rats eat an estimated 26 million tons of food annually. Investigations were carried out to test the efficacy of Drat (chlorophacinone) in controlling the Indian black rat *(Rattus rattus)* in warehouses and residential buildings on the campus of the Indian Institute of Technology, Kharagpur, West Bengal. A concentration of 0.0125 percent of the anticoagulant Drat in bait material of 96 percent semolina, 3 percent oil, and 1 percent sugar eliminated a total of 39 rats in a 2-week period. It is concluded that Drat in this concentration can control rats and mice in village houses and stores, commercial warehouses and residential buildings.

Attempts to Influence the Feeding Behavior of Brown Rats Using Ultrasonic Noise Generators

A.P. Meehan–Chief Biologist, Rentokil Limited, East Grimstead, Sussex. INTERNATIONAL PEST CONTROL 18(4): 12-15, July-August 1976.

It is known that sound has effects on the behavior and physiology of rodents. Four commercial ultrasonic noise generators were tested to assess their effect on the feeding behavior of colonies of wild *Rattus norvegicus* in simulated field conditions. The units were placed 0.5 meters from the rats' accustomed feeding sites. Although there were initial reductions in food consumption, the reductions were either insignificant or short-lived. The results are in line with previously published studies. Ultrasonic devices currently on the market are largely ineffective in repelling rat populations. In addition, the problem of placing such units so as to cover large areas (high frequency sound dissipates rapidly and does not penetrate solid objects) and the capacity of rats to become habituated to the noise confirms that ultrasonic devices are unlikely to play an effective role in rodent control.

A Comparative Field Trial, Conducted without Pretreatment Census Baiting, of the Rodenticides Zinc Phosphide, Thallium Sulphate and Gophacide against *Rattus norvegicus*

B.D. Rennison–Pest Infestation Control Laboratory, Ministry of Agriculture, Fisheries and Food, Hook Rise South, Tolworth, Surbiton, Surrey. JOURNAL OF HYGIENE 77(1): 55-62, August 1976.

Author's summary: The effectiveness of the single-dose poison treatments of farm rat infestations, analyzed by comparing the weights of the post-treatment census bait takes in covariance with the weights of the pre-bait takes, showed that treatments with 2.5 percent zinc phosphide, 0.3 percent thallium sulphate or 0.3 percent gophacide were equally effective and significantly better than were treatments with 1 percent zinc phosphide or 0.1 percent thallium sulphate. [The two latter treatments were only 66 percent and 72 percent effective respectively, whereas the three former treatments were 84, 84, and 85 percent effective respectively. Use of a damp bait would probably not increase effectiveness, and stronger concentrations, especially of thallium sulphate and gophacide, would increase risks to non-target animals and to operators.] The methodology and sensitivity of different analyses are also considered.

Responses of Rattus Species to Anticoagulant Poisoning

K. Muktha Bai and M.K. Krishnakumari–Infestation Control and Pesticides, Central Food Technological Research Institute, Mysore-570013, India. COMPARATIVE PHYSIOLOGY AND ECOLOGY 1(4): 129-35, October 1976.

Authors' abstract: The efficiency of some anticoagulants like warfarin, coumachlor, fumarin, coumatetralyl, diphacinone and chlorophacinone was evaluated at the recommended dosages of 0.005 percent and 0.025 percent against *Rattus* species in cage, rattery and field conditions. The test chemicals killed all the albino rats *(Rattus norvegicus)* within 9 days under captivity. The mortality of roof rats *(Rattus rattus)* ranged from 62.5 percent to 100 percent under similar conditions. Coumatetralyl, diphacinone and chlorophacinone killed all roof rats housed in the rattery within 9 days whereas only 87.5 percent of the test animals succumbed to warfarin, fumarin and coumachlor. [In field trials, warfarin baiting (0.025%) only partially reduced roof rat population as did coumachlor (0.025%), but coumachlor failed to kill house mice despite high poison bait consumption.] Though variations in mortality were observed, the consumption pattern of poison baits by roof rats under different test conditions was similar. The possible reasons for the observed results are discussed. [Candidate chemicals should be tested under different situations and on different species of rodents. It seems that the indandiones and coumatetralyl are the best choices among the anticoagulants for the control of *Rattus* species.]

Warfarin Resistance: A Balanced Polymorphism in the Norway Rat

J.H. Greaves, R. Redfern, P.B. Ayres, and J.E. Gill–Pest Infestation Control Laboratory, Ministry of Agriculture, Fisheries and Food, Hook Rise South, Tolworth, Surrey. GENETICAL RESEARCH 30(3):257-63, 1977.

Authors' summary: The frequency of monogenic resistance to anticoagulant rodenticides in *Rattus norvegicus* in an area straddling the England-Wales border was monitored from 1967

until 1975. Rats were trapped on farms and tested in laboratory by administering a dose of warfarin lethal to susceptibles. The mean incidence of resistance was 44 percent and did not change significantly, despite the extensive use of anticoagulants by farmers during the 9-year period. In 1975 more refined techniques showed that the frequencies of susceptible (SS) and resistant (RR) homozygotes were significantly below the Hardy-Weinberg expectations and simple estimates of the relative fitness ratios for the RR, RS, and SS phenotypes were 0.37, 1.0, and 0.68 respectively. In two relatively isolated valleys, where selection with anticoagulants was minimal, the frequency of resistance decreased significantly from 57 percent to 39 percent during 1973-5. The results are consistent with the hypothesis that a balanced polymorphism is being maintained. Selection against susceptible homozygotes by the use of anticoagulant rodenticides, and against the resistant homozygote due to its high susceptibility to a primary deficiency of vitamin K gives the heterozygotes a selective advantage. A number of ecological factors that influence the incidence of the resistance are discussed briefly.

The Population Dynamics of Genetically Determined Resistance to Warfarin in *Rattus norvegicus* from Mid Wales

J.A. Bishop, D.J. Hartley, and G.G. Partridge–Department of Genetics, University of Liverpool, Liverpool L69 3BX, England. HEREDITY 39(3):389-398, 1977.

Authors' summary: Dominant warfarin resistance and a recessive haemorrhagic trait are apparently controlled by the same allele Rw^2. Twenty-eight F_2 litters and 18 backcross litters of wild rats were scored for resistance when 8 weeks of age. There was a deficiency of resistant males in the F_2 litters whereas phenotypic ratios were close to expectation in F_2 females and backcrosses. Any deficiency of resistant males in F_2 litters could be due to the selective death of the Rw^2Rw^2 genotype. The size of F_2 and backcross litters at birth is similar whereas by 8 weeks the former are significantly smaller than the latter.

Samples of rats from populations in mid Wales were scored for resistance. There was a significant decline in the frequency of phenotypic resistance in one large population ($N \approx 500$) starting when the frequency of Rw^2 allele was relatively low (*c.* 0.10-0.23). Since few alleles can be lost by selective death of Rw^2Rw^2 males in these circumstances it appears that, in the absence of warfarin, the heterozygote may also be at a selective disadvantage.

Where rats are intensively poisoned with warfarin both Rw^2 and its alternative Rw^1 are maintained in populations by heterozygous advantage. The ecological unreality of the concept of segregational load is discussed.

Strong selection influences the frequency of the alleles of *Rw*. Chance must also have an important role. Populations of rats in rural areas are widely scattered and sometimes small in size. There is an unpredictable amount of movement between these populations which occur in very heterogeneous environments.

Laboratory Evaluation of the Effectiveness of a New Acute Rodenticide, *Pyriminyl*, on Albino Rats and Mice (Japanese)

Y. Ito, M. Miyashita, M. Takaoka, and I. Tanaka–Department of Enviromental Biology, Japan Environmental Sanitation Center, Kawasaki, Japan. EISEI DOBUTSU 28(4): 349-54, 1977.

English summary: The effectiveness of a new acute rodenticide, *Pyriminyl*, on rats and mice was investigated. The LD_{50} values of *Pyriminyl* were 24.4-26 mg/kg in male rats, 12.2-27.9 mg/kg in female rats, 68.8-90 mg/kg in male mice, and 56-68 mg/kg in female mice. In the experiments conducted using only 2 percent baits, all mice died within 1 day and all rats died within 5 days. In experiments between 2 percent baits and rolled barley, no difference of acceptance was observed in mice, but rats showed a little lower acceptance to poison baits. In the preliminary experiments, using 1 percent powdered baits and powdered nonpoison baits, however, no avoidance to poison baits was observed in rats and all died within 3 days.

Finding New Means to Attack the Rat

Anonymous. INDIAN JOURNAL OF PEDIATRICS 44(348): 24, January 1977.

Rats, which outnumber humans ten to one in some countries of Southeast Asia, spread diseases such as plague, murine and scrub typhus, leptospirosis and several strains of salmonella. Rats consume 33 million tons of food a year and eat or spoil 20 percent of the crops even before harvest.

According to studies at the Rodent Control Demonstration Unit of the World Health Organization in Rangoon, Burma, rodenticides can only be partially sucessful in the control of large populations of rats. Therefore insecticides will also have to be used to destroy the rat flea, the main vector responsible for the transmission and spread of bubonic plague. Even then, improvements in community sanitation will be necessary in order to control effectively the rat population.

Augmentation of Warfarin Toxicity by Vitamin A Acetate to Roof Rats (*Rattus rattus*)

M.K. Krishnakumari and S. Muralidhara–Central Food Technological Research Institute, Mysore 570 013, India. JOURNAL OF FOOD SCIENCE AND TECHNOLOGY 14(1): 26-28, January-February 1977.

Authors' summary: Resistance of rodents to warfarin and other anticoagulants has lead to intensive research on improving the existing rodenticides and synthesis of newer compounds. Currently, vitamin K antagonists, antibiotics, and vitamin D are being utilized to combat the resistance problem among rodent populations. It is observed that vitamin A acetate at 0.2 percent in combination with warfarin at 0.005 percent baits increased the mortality (100%) in roof rats (*Rattus rattus*) as against warfarin alone (40%) at this concentration. The onset of symptoms was faster and more severe in animals ingesting the baits containing both vitamin A acetate and warfarin than with warfarin alone. The result indicated that vitamin A acetate can potentiate warfarin poisoning in rats resulting in higher mortalities even at lower concentrations of warfarin.

Ultrasonic Rat Control System

P.J. Ebaugh and T. Fortman–University of Detroit, Detroit, MI 48221. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS 13(4): 440, July 1977.

Authors' abstract: A large-scale central system to effectively control rats in warehouses and other similar environments has been developed. The system employs high-powered ultrasonic noise which drives the rats out of the noise covered area and protects against further infestation. The ultrasonic noise emitted from the numerous transducers does not disturb humans in the area for it is higher in frequency than the normal hearing threshold. The central system approach, utilizing one amplifier, signal source and a distributed network of transducers, eliminates duplicity of electronics and this method leads to low system cost and high reliability.

Report on DLP-787 Use in Cleveland

B.T. Marsh and W.B. Jackson–(Mr. Jackson) Environmental Studies Center, Bowling Green State University, Bowling Green, OH 43402. PEST CONTROL 45 (11): 51-52, November 1977.

Tests were conducted to measure the efficacy of the new acute rodenticide Vacor (or DLP-787) when used in an inner city environment. Five blocks in Cleveland's Glenville area, having Norway rat infestations including some warfarin-resistant rats, were chosen to undergo an application program typical of urban rat control projects. Almost 6 weeks after baiting periodically with DLP-787, 86 percent of the initial burrows observed were still closed. New burrow systems on previously uninfested properties had not developed. No accidental ingestion of baits by children or non-target animals occurred.

The development of new and effective acute rodenticides such as DLP-787 suggests the need for reevaluation of large scale control programs. Acute (single dose) toxicants require less manpower but probably should not be used repeatedly (no more than several times a year) to avoid bait shyness and aversion. It is desirable to use both acute and chronic toxicants wisely, and then only as a supplement to environmental sanitation.

Toxicity of Calciferol, Warfarin and their Combinations to *Rattus norvegicus* (albino) and *R. rattus*

K. Muktha Bai, M.K. Krishnakumari, and S.K. Majumder–Infestation Control and Pesticides, Central Food Technological Research Institute, Mysore 570013, India. PESTICIDE SCIENCE 9(1):44-50, 1978.

Authors' abstract: The response of *Rattus norvegicus* and *R. rattus* to calciferol, warfarin and a combination of these compounds was tested. Both species succumbed to the recommended bait concentrations of calciferol (1000 mg/kg) and warfarin (250 mg/kg) when tested individually. However, *R. rattus* was more susceptible to lower concentrations of calciferol (500 and 750 mg/kg) as compared to *R. norvegicus*, which was sensitive to lower concentrations of warfarin (12.5 and 25 mg/kg bait). Addition of calciferol at different concentrations did not affect the toxicity of warfarin against *R. norvegicus*. However, with *R. rattus* calciferol (250-350 mg/kg) or warfarin (50 mg/kg bait), which individually produced partial mortality, in combination produced a complete kill besides accelerating death. Combination of higher dosages of calciferol with warfarin (1000+250 mg/kg bait) tested against both species showed no advantages, resulting in neither lower bait consumption nor speedier death, though individually the components gave complete kills.

Field Trials of WBA 8119 (PP 581, Brodifacoum) against Warfarin-Resistant Infestations of *Rattus norvegicus*

B.D. Rennison and A.C. Dubock–Pest Infestation Control Laboratory, Ministry of Agriculture, Fisheries and Food, Hook Rise South, Tolworth, Surbiton, Surrey. THE JOURNAL OF HYGIENE 80(1):77-82, February 1978.

Authors' summary: Baiting with medium oatmeal or soaked wheat containing 0.002, 0.001, or 0.0005 percent brodifacoum [3-(-3(4'-bromobiphenyl-4-yl)-1,2,3,4-tetrahydronaphth-l-yl)-4 hydroxycoumarin], completely controlled infestations of warfarin-resistant rats on farms when the poisoned baits were maintained until rats ceased to feed on them. The concentration of brodifacoum did not affect the duration of these treatments which lasted from 11 to 25 days.

Poison baiting with 0.002 percent brodifacoum for only 1, 4, and 7 days achieved, respectively, only about 41, 51, and 68 percent control of similar farm infestations, and so emphasized the need to continue baiting for longer periods.

Selected Bibliography

Academia Sinica, Peking Institute of Zoology, Department of Animal Ecology; The attractive effect of rat urine odor and its possible use in rat control (Chinese). ACTA ZOOLOGICA SINICA 21(1):46-50.

*Anonymous: Finding new means to attack the rat. INDIAN JOURNAL OF PEDIATRICS 44(348):24, Jan 1977.

*Bai KM, Krishnakumari MK: Responses of *Rattus* species to anticoagulant poisoning. COMPARATIVE PHYSIOLOGY AND ECOLOGY 1(4):129-35, Oct 1976.

*Bai KM, Krishnakumari MK, Majumder SK: Toxicity of calciferol, warfarin and their combinations to *Rattus norvegicus* (albino) and *R. rattus*. PESTICIDE SCIENCE 9(1):44-50, 1978.

Barnes AM: Problems of rodent control in rural tropical areas. BULLETIN OF THE WORLD HEALTH ORGANIZATION 52(4-6):691-96, 1976.

Bhatnagar RK, Butani DK: Significance of rodent control. PESTICIDES pp. 61-66, 1976.

Bieri R, Prevot RL, Graf A: Possibilities for chemical rat control field crops, animal pests (German). MITTEILUNGEN FUER DIE SCHWEIZERISCHE LANDWIRTSCHAFT 25(4):88-95, Apr 1977.

*Bishop JA Hartley DJ, Partridge GG: The population dynamics of genetically determined resistance to warfarin in *Rattus norvegicus* from mid Wales. HEREDITY 39(3):389-98, 1977.

Blumberg T, Chavis M, Cowan C, et al: Rat control: an interdisciplinary approach. Hill FB: Student-originated studies projects, 1973. Abstract reports. Presented at meetings in Washington, D.C., Dec 26-29, 1973. National Science Foundation: Washington, D.C., pp. 259-65, 1974.

Brooks JE, Bowerman AM: Analysis of susceptibilities of several populations of *Rattus norvegicus* to warfarin. THE JOURNAL OF HYGIENE 73(3):401-07, 1974.

*Brooks JE: A review of rodent control programs in New York state. PROCEEDINGS OF THE VERTEBRATE PEST CONFERENCE 6:132-43.

Bull JO: Rodent control on farms. INTERNATIONAL BIODETERIORATION BULLETIN 11(3):6, 1975.

Cornwell PB: Present and future requirements of pest control in the food industry. COMMUNITY HEALTH (BRISTOL) 7(4):205-14, Apr 1976.

Cowan PE: Toxicity of a new rodenticide, Vacor. CURRENT SCIENCES 46(13):453-54, 1977.

Davis RA: Methods for laboratory testing of rodenticidal dusts. BULLETIN OEPP 7(2):479-83, 1977.

*Ebaugh PJ, Fortman T: Ultrasonic rat control system. IEEE TRANSACTIONS ON AEROSPACE AND ELECTRONIC SYSTEMS 13(4):440, 1977.

Falter J: Rodent control around poultry farms. POULTRY POINTERS, Dec 1976.

Fellows DP, Sugihara RT: Food habits of Norway and Polynesian rats in Hawaiian sugarcane fields. HAWAIIAN PLANTERS' RECORD 59(6):67-86.

Food and Fertilizer Technology Center for the Asian and Pacific Region: Asian rats and their control. Tapei: The Center, 1976.

Fradois: What is bromadiolone? Rodenticides (French). DEFENSE DES VEGETAUX 30(182):279-81, 284-88, Nov-Dec 1976.

Georgiev B, Lilov K: Trends in the development of rodent control (Czech). VETERINARSKY SBORNIK 74(10):32-34, 1976.

Girish GK, Jain SK, Arora KK: Studies on rodents and their control. 12. Studies on rat control in a village with anticoagulant. BULLETIN OF GRAIN TECHNOLGOY 13(2):73-77, 1975.

*Abstracted

Greaves JH, Choudry MA, Khan AA: Pilot rodent control studies in rice fields in Sind, Pakistan, using rodenticides. AGRO-ECOSYSTEM 3(2):119-30.

*Greaves JH, Redfern R, Ayres PB, Gill JE: Warfarin resistance: a balanced polymorphism in the Norway rat. GENETICAL RESEARCH 30(3):257-63, 1977.

*Ito Y, Miyashita M, Takaoka M, Tanaka I: Laboratory evaluation of the effectiveness of a new acute rodenticide, *Pyriminyl*, on albino rats and mice (Japanese). EISEI DOBUTSU 28(4):349-54, 1977.

Jackson WB, Brooks JE, Bowerman AM, Kaukeinen DE: Anticoagulant resistance in Norway rats as found in US cities. PEST CONTROL 43(4):12, Apr 1975.

*Krishnakumari MK, Muralidhara S: Augmentation of warfarin toxicity by vitamin A acetate to roof rats (*Rattus rattus*) rodent control. JOURNAL OF FOOD SCIENCE AND TECHNOLGOY 14(1):26-28, Jan-Feb 1977.

Kovalenko LI, Bulkina VA, Panteleev RI: Three cases of glyfluorine poisoning (Russian). GIGIENA TRUDA I PROFESSIONAL'NYE ZABOLEVANIIA 12:53-54, 1976.

Landreth HF, Christensen MT, Bussjaeger LJ, et al: Influence of genetically sterile males on fecundity of Norway rats. BIOLOGY OF REPRODUCTION 15(3):390-95, Oct 1976.

*Marsh BT, Jackson WB: Report on DLP-787 use in Cleveland. PEST CONTROL 45(11):51-52, Nov 1977.

Marsh CA: Rats and mice: Ohio recommendations on rodent control in poultry houses. CORNELL POULTRY POINTERS 27(1):13-16, Apr 1976.

Marsh RE, Howard WE: House mouse control manual. II. Rodenticides. PEST CONTROL 44(9):21-22,24, 26,28,53-54, Sept 1976.

Marsh RE, Howard WE: House mouse control manual. III. Rodenticides. PEST CONTROL 44(10):27-28, 31-32,34,36,38,43-45, Oct 1976.

Matschke GH, Fagerstone KA: Effects of a new rodenticide, benzenesulfonic acid hydrazide, on prenatal mice. JOURNAL OF TOXICOLOGY AND ENVIRONMENTAL HEALTH 3(3):407-11, 1977.

*Meehan AP: Attempts to influence the feeding behavior of brown rats using ultrasonic noise generators. INTERNATIONAL PEST CONTROL 18(4):12-15, Jul-Aug 1976.

Meehan AP: The evaluation of contact rodenticides for mouse control. INTERNATIONAL BIODETERIORATION BULLETIN 12(2):59-63, Summer 1976.

Meehan AP: A new rodenticide for warfarin-resistant mice. CHEMIST AND DRUGGIST 209(5099):20, 1978.

Mishra S: Rat control at no cost using the bark of underground roots of bauhinia purpuria. INTEN AGRIC 14(10):19, Dec 1976.

Mohan Rao HN: Some aspects of rodenticides used in India. PESTICIDES 10(4):52-54, Apr 1976.

*Mortenson EW, Rotramel GL: A regional approach to rodent control in the San Francisco bay area. PROCEEDINGS OF THE VERTEBRATE PEST CONFERENCE 7:235-41, 1976.

Oddone G: Rodent control on a large scale: a problem also to be faced in Italy (Italian). Domenichini G, ed: FIRST SYMPOSIUM ON CONTROL OF PARASITES IN THE FOOD INDUSTRY AND FOOD PROTECTION (Piacenza, Italy, Oct 18-20, 1972). Piacenza: Camera di Commercio Industria Artigianato e Agricoltura di Piacenza, pp. 448-51, 1975.

Omel'janec TG: Resistance of the salmonella used for deratization to some environmental factors (Russian). GIGIENA I SANITARIIA (4):99-101, Apr 1976.

Omel'janec TG: Survival of Isachenko salmonellae in food products (Russian). VOPROSY PITANIIA (5): 65-67, Sep-Oct 1976.

Omel'janec TG: Survival of salmonellas used for harmful rodent control in the environment (Russian). MIKROBIOLOHICHNYI ZHURNAL 38(6):761-64, Nov-Dec 1976.

Otashev SN: Bactoratindan—an effective substance against mouse-like rodents (Russian). VETERINARIIA (2):38-39, Feb 1976.

Parpia HA: Postharvest losses—impact of their prevention on food supplies, nutrition, and development. BASIC LIFE SCIENCES 7:195-206, 1976.

*Abstracted

Pinel JPJ: Potential of high-intensity ultrasonic sound in rat control–reply. PSYCHOLOGICAL REPORTS 35(3):1084, 1974.

Prakash I: Rodent control in rural and urban areas. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCE OF INDIA, SEC. B 46(1/2):156-60, 1976.

Rashkov D, Iovchev E: Significance of sugars in baits for gray rats' rodenticides (Czech). VETERINARSKY SBORNIK 74(10):32-34, 1976.

*Rennison BD: A comparative field trial, conducted without pretreatment census baiting, of the rodenticides zinc phosphide, thallium sulphate, and gophacide against *Rattus norvegicus*. THE JOURNAL OF HYGIENE 77(1):55-62, Aug 1976.

*Rennison BD, Dubock AC: Field trials of WBA 8119 (PP 581, brodifacoum) against warfarin-resistant infestations of *Rattus norvegicus*. THE JOURNAL OF HYGIENE 80(1):77-82, Feb 1978.

Rowe FP, Swinney T, Bradfield A: Trials of the rodenticide pyriminyl against wild house mice (*Mus musculus* L.). THE JOURNAL OF HYGIENE 80(2): 315-19, Apr 1978.

Rybin AP: Use of bactorodencide in rodent control (Russian). VETERINARIIA (3):52-53, Mar 1977.

Schulze G: Large-scale rat control (German). PRAKTISCHE SCHADLINGSBEKAMPF 28(2):9-11, Feb 1976.

*Schuyler HR, Sun RF Jr: Trapping a continuous integral part of a rodent control program. PROCEEDINGS OF THE VERTEBRATE PEST CONFERENCE 6:150-60.

Sims CW, Gard RK: High pressure liquid chromatographic determination of *N*-3-pyridylmethyl-*N'*-*p*-nitrophenylurea in rodenticides. JOURNAL OF THE ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS 60(6):1375-78, 1977.

*Singh K, Ojha TP: Rat control with an anticoagulant–Drat. INTERNATIONAL PEST CONTROL 18(3):10, May-Jun 1976.

Sintsova LY, Serebrya LK, Kozhemya NG, Kositska AD: Use of bacterial method of rodent control (Russian). ZHURNAL MIKROBIOLOGII EPIDEMIOLOGII I IMMUNOBIOLOGII 1974(3):133-35, 1974.

Srinath D: Rodent control: a perspective. PESTICIDES pp. 58-60, 1976.

*Stanley AJ, Gumbreck LG, Allison JE, Landreth HF: A 3-year history of the use of the genetically sterile male Norway rat in the control of wild rat populations. TEXAS REPORTS ON BIOLOGY AND MEDICINE 32(2):596.

Subih KS: Rat control in poultry farms. INDIAN POULTRY REVIEW 7(20):18-22, Jun 1, 1976.

*Tanaka I, Ito Y, Shigeta H: Studies on the effectiveness of rodenticides. I. The comparative rodenticidal efficacy of several anticoagulants (Japanese). EISEI DOBUTSU 27(4):347-53, 1976.

Timchenko LI: A knapsack apparatus for the distribution of bait (Russian). ZASCHITA RASTENII (Moscow) (9):26.

Wegner Z, Kruminis-Lozowska W: Laboratory research into the utilization of the common castor-oil plant (*Ricinus communis* L.) in the control of rats. BULLETIN OF THE INSTITUTE OF MARITIME AND TROPICAL MEDICINE IN GDYNIA 27(2):229-40, 1976.

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