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# FIELD EVALUATION OF THREE ANTICOAGULANT RODENTICIDES AGAINST *Mus musculus* POPULATIONS IN APARTMENTAL BUILDINGS IN NEW YORK CITY

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ABSTRACT: Field efficacy studies using three anticoagulant rodenticides were conducted on House mice, *Mus musculus* under a variety of conditions in 35 apartmental buildings scattered over four boroughs of New York metropolitan area. Percent control successes and relative efficacies of various rodenticides and their formulations were determined by recording pre and post control census for about four years.

After four monthly treatments, the control success rate of bromadialone (0.005%, meal form) was highest (94.5%) followed by brodifacoum (0.005%, pellet form, 91.23%) and diphacinone (77.72%) in the wax cake formulation. However, build up of the residual mice population was faster in the case of bromadialone treatment when compared to brodifacoum ($P<.01$). Results of intermittent control operation, bi-monthly and biweekly, are compared and discussed with respect to mice population dynamics and properties of the rodenticides.

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## INTRODUCTION

House mice, *Mus musculus domesticus* (Rutty) is one of the most widely distributed and productive rodent species in the north east region of the USA, including New York. Out of three prevalent commensal rodents viz, Norway rat, *Rattus norvegicus,* Roof rat, *Rattus rattus* and House mouse, *Mus musculus;* Norway rat and House mice are two predominant species in the New York metropolitan area. However, in fewer instances only, these two species have been found to co-exist (Advani 1992). More effective control of Norway rat has opened up new environments for the House mice. Therefore, from an economical point of view, it is today more important than Norway rat. While disease transmission potential of mice is not as great as rats, its ubiquitous nature, adaptability, high reproductive potential and resistance to control measures (Jackson 1990) has resulted into bigger problems. By 1980, resistance was an established phenomenon in Norway rat populations (Jackson 1987). Ashton and Jackson (1984) identified resistant mice populations from several cities in USA including New York (Buffalo), but due to unavailability of Federal and State Funds for continued research these studies could not be undertaken. Resistance to second generation rodenticides among mice populations has already been reported from Canada (Siddiqui and Blaine 1982).

About 450 private pest control companies, besides governmental agencies, are involved in rodent control work in New York City and mice problem poses a biggest challenge to them. Due to economical reasons and lack of updated knowledge, it is very common for PCO's to use only one of the three most commonly available anticoagulant rodenticides viz; bromadialone (Maki®), brodifacoum (Talon®) and diphacinone on a continuous basis (1-2 years) in the same residential and commercial account. This has resulted into failure to achieve a satisfactory control success on a long term basis due to probable development of resistance among mice populations to these anticoagulants. Similarly PCO's from all over the country have reported that they could no longer control some mouse populations (Jackson 1987).

The present studies were conducted to evaluate comparative efficacy of these three major anticoagulants rodenticides and their respective formulations. An attempt has been made to analyze comparative efficacy of two commonly used tracking powders, Rozol® (chlorophacinone) and ZP® Tracking Powder (zinc phosphide) against mice populations. Usefulness of glue traps for initially cleaning out mice populations and then maintenance of buildings using two single dose anticoagulants is also evaluated and discussed.

## MATERIALS AND METHODS

Thirty five apartmental buildings located in four boroughs (Queens, Brooklyn, Bronx, Manhattan) of New York metropolitan area were selected for these studies. All buildings were exclusively infested with House mice at relatively higher infestation levels. The experiments on efficacy of anticoagulant baits, tracking powders and glue traps were conducted in the basements of these buildings to avoid any disturbance. The pre and post control size of mice populations before and after each treatment were estimated using Sherman live traps (7.6 x 7.6 x 22.0 cms) placed at an interval of 10 feet, approximately following Spaulding and Jackson (1984). Post control trap indices were recorded after 7 to 10 days of placement of the poison baits in the tamper proof bait stations established at an interval of 8 to 12 feet. Depending upon pre control mice populations density (trap indices), 1/2 to 2 ounces of anticoagulant bait or wax blocks were placed in the bait stations. Consumed baits were replenished periodically. Tracking powders using chlorophacinone (0.2%; Rozol) and zinc phosphide (10% ZP Tracking Powder) were applied following Marsh (1985). Utilizing bulb dusters, wall voids were also treated with tracking powders.

## RESULTS AND DISCUSSION

All of the apartmental buildings in four boroughs of New York, where these studies were conducted showed no signs of infestation of Norway or Roof rats. These buildings (basement and apartments) were exclusively (100%) infested by House mouse. As revealed from trap indices and other signs of infestation (droppings, etc.), the establishment of mouse populations at a relatively higher level in the residential habitat of New York may be attributed to their high reproductive potential (Southwick 1969) and the conducive conditions prevalent in this densely populated metropolitan city. These

Table 1. Relative efficacy of three anticoagulant rodenticides and their formulations against *Mus musculus* populations in apartmental buildings.

| | | | Months (1987-88) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Treatment Phase | | | | Post (Non) Treatment Phase | | | |
| Rodenticide | Formulation | | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May |
| Brodifacoum | Pellet | 1. | 22.40[a] | 10.56 | 6.60 | 3.82 | 2.17 | 2.07 | 3.15 | 4.75 |
| (.005%) | | 2. | 8.25 | 4.78 | 2.07 | 1.96[b] | | | | |
| | | 3. | 63.16 | 54.73 | 68.63 | 48.69 | | | | |
| Brodifacoum | Weather | 1. | 20.72 | 12.50 | 7.84 | 5.66 | 2.89 | 3.35 | 3.27 | 4.51 |
| (.005%) | Bait | 2. | 10.62 | 6.72 | 3.90 | 2.62 | | | | |
| | Block | 3. | 48.74 | 46.24 | 50.25 | 53.71 | | | | |
| Bromadialone | Pellet | 1. | 17.51 | 7.55 | 5.60 | 5.51 | 3.70 | 5.62 | 7.81 | 8.88 |
| (.005%) | | 2. | 5.91 | 3.92 | 2.70 | 1.88 | | | | |
| | | 3. | 66.24 | 48.07 | 51.78 | 65.88 | | | | |
| Bromadialone | Meal | 1. | 18.50 | 10.24 | 5.78 | 4.89 | 3.61 | 5.52 | 6.89 | 9.21 |
| (.005%) | | 2. | 5.02 | 2.75 | 1.21 | 1.01 | | | | |
| | | 3. | 72.86 | 73.14 | 79.06 | 79.34 | | | | |
| Diphacinone | Weather | 1. | 15.62 | 12.32 | 10.14 | 7.29 | 5.86 | 8.34 | 8.00 | 9.20 |
| (.005%) | Bait | 2. | 8.79 | 6.70 | 5.35 | 3.48 | | | | |
| | Block | 3. | 43.72 | 45.61 | 47.23 | 52.26 | | | | |

1 = Pre Control Trap Index, 2 = Post Control Trap Index, 3 = %Control Success.
[a,b]The final % control success figures are based on Pre Control indices (October) and Post Control indices (January)

Table 2. Impact of bimonthly and biweekly rodenticidal treatments on *Mus musculus* populations.

| | | | | Treatment Number | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Frequency | Rodenticide | Formulation | | 1 | 2 | 3 | 4 | 5 | 6 |
| Bimonthly | Brodifacoum | Pellet | a. | 18.45 | 10.50 | 7.80 | 4.71 | 1.98 | 0.96 |
| | (.005%) | | b. | 4.80 | 3.12 | 3.24 | 1.02 | 0.00 | 0.00 |
| | | | c. | 73.98 | 70.28 | 58.46 | 78.34 | 100 | 100 |
| | Bromadialone | Meal | a. | 15.72 | 12.33 | 10.82 | 7.28 | 5.32 | 4.27 |
| | (.005%) | | b. | 4.20 | 2.88 | 2.78 | 1.50 | 0.84 | 0.00 |
| | | | c. | 73.28 | 76.64 | 74.30 | 79.39 | 84.21 | 100 |
| Biweekly | Brodifacoum | Pellet | a. | 13.79 | 5.05 | 1.89 | 0.89 | 0.00 | 0.67 |
| | (.005%) | | b. | 3.27 | 1.72 | 0.66 | 0.00 | 0.00 | 0.00 |
| | | | c. | 76.28 | 65.94 | 65.07 | 100 | 100 | 100 |
| | Bromadialone | Meal | a. | 14.25 | 6.20 | 3.22 | 1.88 | 0.67 | 0.00 |
| | (.005%) | | b. | 3.17 | 1.90 | 0.67 | 0.00 | 0.00 | 0.00 |
| | | | c. | 77.75 | 69.35 | 79.19 | 100 | 100 | 100 |

a = Pre Control Trap Index, b = Post Control Trap Index, c = %Control Success

conditions include poor sanitary status, availability of harborage and lack of proper maintenance of the buildings. Besides these factors, continuous use of available anticoagulant rodenticides have probably resulted into the existence of resistance or cross-resistance (Fukui 1985) among mice populations, the aspect which needs further investigation. Anticoagulant resistance in House mouse has already been reported from Buffalo, New York (Ashton and Jackson 1984) and Toronto area of Canada (Siddiqui and Blaine 1982).

Hitherto, several laboratory studies on efficacies of multiple (diphacinone) and single dose (bromadialone, brodifacoum) against House mice have revealed 75 to 100

Table 3. Percent reduction in *Mus musculus* populations using glue traps (3 months) followed by two anticoagulant rodenticides (3 months).

| Glue Traps/ Rodenticide | | Months (1986) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Mar. | Apr. | May | June | July | Aug. |
| Treatment A. | 1. | 14.75 | 6.23 | 6.45 | — | — | — |
| Glue Traps | 2. | 2.34 | 1.24 | 0.67 | — | — | — |
| | 3. | 84.13 | 80.09 | 89.61 | — | — | — |
| Bromadialone | 1. | — | — | — | 2.88 | 1.43 | 2.24 |
| (.005%, Meal) | 2. | — | — | — | 0.67 | 0.00 | 0.00 |
| | 3. | — | — | — | 76.73 | 100 | 100 |
| Treatment B. | 1. | 17.27 | 8.38 | 6.51 | — | — | — |
| Glue Traps | 2. | 4.50 | 2.34 | 1.12 | — | — | — |
| | 3. | 73.94 | 72.07 | 81.41 | — | — | — |
| Brodifacoum | 1. | — | — | — | 3.65 | 1.35 | 1.80 |
| (.005% Pellet) | 2. | — | — | — | 1.20 | 0.00 | 0.21 |
| | 3. | — | — | — | 67.12 | 100 | 88.33 |

1 = Pre control Trap Index, 2 = Post control Trap Index, 3 = %Control Success

percent control of this major rodent pest during a short period of time (Poch6 1986, Kaukeinen and Rampaud 1986).

Application of rodenticide baits on a monthly basis (once/month) is a common frequency of service for apartmental buildings in New York. During present field trials, monthly treatments with bromadialone (.005%) in meal form (Table 1) produced highest percent control success (94.5%) after four months as shown by pre control census (Oct 1987) and post control census (Jan. 1988). It was closely followed by brodifacoum (.005%, pellets) treatment which resulted into a reduction of 91.2% mice densities after four months. Bromadialone (pellets) and brodifacoum (bait blocks) controlled mice populations at a level of about 89.3 and 87.3% respectively. While, least percent control success (77.7%) was obtained with diphacinone (.005%) in bait block (Eaton's) formulations. In other studies during field trials, Marsh et al. (1980) reported 75 to near 100% of mice control using bromadialone in various urban and rural habitats. In the poultry farms, time-pulse baiting technique, produced 74.4 to 78.8% of reduction of mice infestations (Corrigan and Williams 1986) when single dose anticoagulants were used. Most urban trials using brodifacoum (mainly pellet form) have been conducted as outside baiting in burrows around structures (Kaukeinen and Rampaud 1986) and no substantial data is available on its field efficacy inside buildings for comparison with the results of present studies. Relatively low control success rates during present trials is perhaps due to availability of alternative food sources to the mice in the residential building habitat and its migration from adjoining buildings.

During four months of post (non) treatment phase (Table 1), residual mice populations multiplied 9 times in the basements of buildings where bromadialone (meal) was applied as revealed by post control trap index of Jan. 1987 and trap index in the month of May 1988. Whereas, the build up of residual mice densities was about 2.5 times with brodifacoum (pellet) treatment. In general, multiplication of residual mouse populations was much slower ($P<0.01$) in the case of both formulations of brodifacoum when compared to two formulations of bromadialone. The build up of mice populations during post (non) treatment phases may also be due to poor sanitation and maintenance of the building and invasion of rodents from peripheral habitats (Spaulding and Jackson 1984).

During bi-monthly (once/2 months) applications of single dose anticoagulant baits, 100% mice populations were controlled after five (brodifacoum, pellets) and six (bromadialone, meal) treatments (Table 2). Whereas, bi-weekly (once/14 days) treatments of rodent baits resulted into 100% control of mice after four consecutive treatments in the case of both anticoagulants, brodifacoum (pellets) and bromadialone (meal). Comparison of these results with that of monthly (once/month) treatments (Table 1) indicate that almost the same level of control success can be achieved with two frequencies of applications (monthly and bi-monthly) after four treatments. Whereas, bi-weekly placement of anticoagulant baits provide relatively short time for residual mice populations to recover and hence 100% control can be achieved within two months' period only. In the cropfield habitat, a mixed population of rodents was controlled at 100% level when acute rodenticide, zinc phosphide (2%) was used for seven seasons at a six-monthly interval (Advani et al. 1988).

Use of glue traps on a monthly basis for thee months for initial clean out of high densities of mice population produced 95.5 and 93.5% control successes during Treatment A and Treatment B respectively (Table 3). Establishment of bait stations containing brodifacoum (pellets) or bromadialone (meal) controlled remaining mice at a 100% level after only two treatments. In one control program, glue boards removed more than 3000 mice out of a cold storage facility in less than

Table 4. Reduction in *Mus musculus* populations through treatment of anticoagulant and acute tracking powders.

| Tracking Powder | | Months (1988-1989) Oct. | Nov. | Dec. | Jan. | Feb. | Mar. |
|---|---|---|---|---|---|---|---|
| Rozol: | 1. | 14.79 | 10.21 | 6.80 | 4.02 | 2.37 | 2.20 |
| Chlorophacinone | 2. | 6.27 | 5.75 | 3.21 | 1.75 | 1.10 | 0.87 |
| (0.2%) | 3. | 57.60 | 43.68 | 52.79 | 56.46 | 53.58 | 60.45 |
| ZP Tracking Powder: | 1. | 16.67 | 5.58 | 2.70 | 1.12 | 0.71 | 0.00 |
| Zinc Phosphide | 2. | 4.10 | 2.13 | 0.65 | 0.00 | 0.00 | 0.00 |
| (10.0%) | 3. | 75.40 | 61.82 | 75.92 | 100 | 100 | 100 |

1 = Pre Control Trap Index, 2 = Post Control Trap Index, 3 = % Control Success

30 days (Jackson 1990). Recently the glue traps are gaining more importance because of greater restriction of pesticides in food plants and development of anticoagulant resistance among rodents.

Although tracking powders have been used in the control of House mice for a long time, there are relatively few reports of assessing their efficacy under actual use (Rennison 1977, Williams 1977). During present investigations, a 100% reduction in mice population was achieved when zinc phosphide (10%) tracking powder was used for four consecutive months in the basements of the building (Table 4). Whereas, chlorophacinone (0.2%), an anticoagulant tracking powder, exterminated about 94% of House mice when used for six consecutive months. Marsh (1985) states that efficacy of tracking powders varies greatly due to existing circumstances where they are used.

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LITERATURE CITED

ADVANI, R. 1992. Population dynamics of commensal rodents infesting residential and commercial buildings in New York City. Mammalia (In press).

ADVANI, R., I. PRAKASH and R.P. MATHUR. 1988. Reduction in rodent populations through intermittent control operations in the cropping ecosystem of the Indian Desert. In: Proc. 13th Vertebrate Pest Conf. (A.C. Crabb and R.E. Marsh Ed:) Univ. of Calif. Davis, 13:110-122.

ASHTON, A. and W.B. JACKSON. 1984. Anticoagulant resistance in the House mouse in North America. In: Proc. Conf. Organis. Practice of Vertebrate Pest Control (A.C. Dubock Ed.) ICI, Plant Prof. Div. Hampshire, England, 181-188.

CORRIGAN, R.M. and R.E. WILLIAMS. 1986. The House mouse in poultry operations: pest significance and a novel baiting strategy for its control. In: Proc. 12th Vertebrate Pest Conf. (T.P. Salmon Ed.) Univ. of California, Davis, 120-126.

FUKUI, H.H. 1985. Pivalyl resistance in Sprague - Dawley rats (*Rattus norvegicus*) M.S. Thesis. Bowling Green State Univ., Bowling Green, Ohio (Unpublished).

JACKSON, W.B. 1987. Current management strategies for commensal rodents. In Current Mammalogy, Vol. 1 (H.H. Genoways Ed.), Plenum Publ. Corp. 495-512.

JACKSON, W.B. 1990. Rats and Mice Chapter 1. In: Handbook of Pest Control. (Arnold Mallis Ed.), Franzak and Foster, Cleveland, Ohio, 9-85.

KAUKEINEN, D and M. RAMPAUD. 1986. A review of brodifacoum efficacy in US and World wide. In: Proc. 12th Vertebrate Pest Conf. (T.P. Salmon Ed.) Univ. of California, Davis. 16-50.

MARSH, R.E. 1985. Tracking powder as a rodent control technique. Acta Zool. Fennica. 173: 181-183.

MARSH, R.E., W.E. HOWARD and W.B. JACKSON. 1980. Bromadialone: a new toxicant for rodent control. Pest Control 8:22-26.

POCHÉ, R.M. 1986. The status of bromadialone in the United States. In: Proc. 12th Vertebrate Pest Conf. (T.P. Salmon Ed.) Univ. of California, Davis, 6-15.

RENNISON, B.D. 1977. Methods of testing rodenticides in the field against rats. Pest. Sci. 8:405413.

SIDDIQUI, Z., and W.D. BLAINE. 1982. Anticoagulant resistance in house mice in Toronto, Canada. Pest Management, 10-14.

SPAULDING, S.R. and W.B. JACKSON. 1984. Field methodology for evaluating rodenticide efficacy. In: Vertebrate Pest Control and Mgmt. Materials : 4th Symposium, ASTM STP. 817:183-198.

SOUTHWICK, C.H. 1969. Reproduction, mortality and growth of murid rodent populations. In: Indian Rodent Symp., Calcutta. Johns Hopkins Univ. Center Medical Res. and Training, 152-76.

WILLIAMS, R.E. 1977. Field testing Zinc Phosphide tracking powder. Pest Control 45 (11): 26,28,30.