林試研報 Bull. For. & For. Prod. Res. Inst. No. 313, 1981 47～51

Field Trials of the Rodenticide 2-(diphenyl acetyl)-1, 3-indandione against the Japanese Field Vole, *Microtus montebelli* MILNE-EDWARDS

By

Eiji KITAHARA

Summary : Two different field populations of the Japanese field vole, *Microtus montebelli*, were treated with the anticoagulant rodenticide, 2-(diphenyl acetyl)-1, 3-indandione.

The effectiveness of the rodenticide was estimated by the reduction in density of the vole. By the treatment of the rodenticide, 50% of the vole population at the dry riverbed of the Tone river and about 86% at the western slope of Mt. Kinada were controlled.

From the results of trials I and II, it can be concluded that the rodenticide 2-(diphenyl acetyl)-1, 3-indandione, is very effective in the control of the *Microtus montebelli* population.

Introduction

Recently a rodent control system based on a new rodenticide has been studied extensively. Nowadays the most popular and widely used rodenticide in this country is zinc phosphide. It has an acute toxicity and does not induce bait shyness to microtine rodents, and it resolves more quickly in the stomach than the other rodenticides. Moreover, it does not induce any resistance to rodenticides in the rodents. On the other hand, 2-(diphenyl acetyl)-1, 3-indandione used in this trial is an anticoagulant such as warfarin.

In the early 1950s anticoagulant rodenticides were thought to make a turning point in rodent control because of their advantages[1]. But, in 1959 an infestation of rats resistant to anticoagulant rodenticides such as warfarin were discovered and by 1966 the resistant population was reported to have spread in the England-Wales border[2].

The appearance of resistance to warfarin and to other well-known anticoagulant rodenticides in rodent populations has reduced the use of these compounds in urban areas of Britain. The material in this trial is known to kill rodents with a single feeding and not to cause the vole to be resistant as above mentioned. This characteristic is not known in other anticoagulant compounds, which usually require 2 or more feedings for a lethal dosage. Consequently, anticoagulant rodenticies are not used for field rodent control.

This paper deals with the effectiveness of 2-(diphenyl acetyl)-1, 3-indandione in controlling the Japanese field vole populations.

Materials and methods

The object species of this trial is the Japanese field vole, *Microtus montebelli montebelli*, which causes harmful damage to farms and forests in Honshu and Kyushu. This vole inhabits

Received April 30, 1980 保 護—27 For. Protection—27

(1) Forest Protection Division

mainly cultivated land and young forest plantations with a lush growth of grass.

Trial I was carried out from August 28th to September 13th, 1979. The study site of this trial was located on the dry riverbed of the Tone river in Chiba Prefecture. This riverbed has been used as a pasture by neighboring dairy farmers and pasture grass such as ochard-grass remains now. Accordingly, this site is a good habitat for field voles.

Trial II was carried out on the western slope of Mt. Kinada located in the suburbs of Futtsu city in Chiba Pref. from October 24th to November 8th, 1979. This site is also a good habitat for field voles, because of the pasture grass planted there in order to improve the soil which was left after mining sand and small pebbles.

The population density was estimated through the mark and release method[3] in both study areas before laying poisonous bait. Poisonous bait of 50 grams in weight was put at each trapping point and left for six days in trial I and for seven days in trial II.

The effectiveness of the poison treatment was calculated from the total of marked individual numbers during pre- and post-poisonous bait layings. Live-traps were dispersed in a 50×100 m area with an interval of 10 m between each trapping points in trial I and in a 40 ×80 m area in trial II.

Results and discussion

The results from the riverbed of the Tone river are summarized in Table 1. The extremely few catches on the first day seemed to be based on the fact that there were many more voles than the two in sufficient traps at each point could handle and that pre-baiting was not conducted before the actual investigation. On and after the second day, four traps were set at each trapping point and all four traps were fully occupied with voles at many points. The pre-poisonous bait settling census was finished on the seventh day, because the number of marked individuals which were caught on that day reached the high percentage of 80% of the total catches.

Granular poisonous bait of 50 grams in weight was put at each trapping point and it was

Table 1. Result of the mark and release method on the riverbed of the Tone river

	Date (1979)	New ids.	Mark ids.	Total	Mark ids. until the day before counting	Percentage of mark ids. of the total ids.
Pre-traetment census	Aug. 29	59	0	59	0	0%
	30	99	27	126	59	21.4
	31	80	66	146	158	45.2
	Sept. 1	76	89	165	238	53.9
	2	57	121	178	314	68.0
	3	40	129	169	371	76.3
	4	35	141	176	411	80.1
Laying poisonous baits (from the afternoon of Sept. 4th to the morning of Sept. 10th)						
Post-treatment census	Sept. 11	69	97	166	446	58.4
	12	102	54	156	349	34.6
	13	104	32	136	295	23.5

hoped that the amount of bait which would be eaten and taken away by the voles would be discussed. Almost all of the bait was confirmed to have been eaten or carried away by the time of the patrol on the second day after laying the bait, indicating the extremely high density of the vole. For this reason, it was impossible to talk the matter over.

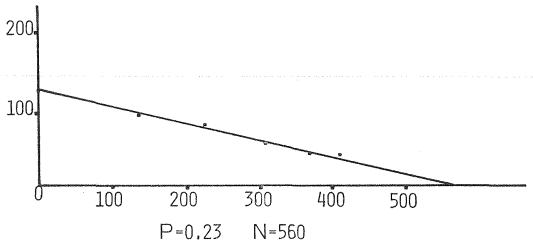

Fig. 1 Estimation of the *Microtus* population through SUGIYAMA's method.

From the results shown in Table 1, the number of voles in this area were presumed to be 560 per 0.5 ha (Fig. 1). This estimation of the *Microtus* population was conducted through SUGIYAMA's method[4] without the catches of the first day.

Four hundred forty-six voles were marked through the mark and release method during the pretreatment census and after laying the bait, and 183 marked voles were caught and removed from this area in three days. This figure will come to about 222 through the same method as mentioned above. And accordingly the effectiveness of this rodenticide is calculated to be about 50% on the *Microtus* population in this trial.

The results from Mt. Kinada are shown in Table 2. In this study area, two traps were dispersed in a 50×80 m grid with an interval of 10 m between each trapping point.

The small number of catches on the first day seemed to be due to the fact that prebaiting was not conducted before the actual investigation. And in this area, the number of voles could not be estimated through SUGIYAMA's method adopted in trial I, because the number of catches on each day were very variable. But, 66 voles were presumed to inhabit this area (0.4 ha), with the basic technique, which seems to have been first used by LINCOLN (1930)[5] to estimate the total number of duck in North America, and is sometimes referred to as the "Lincoln Index"[6].

Seven voles were recaptured during the post-treatment census. Thus, this rodenticide is

Table 2. Result of the mark and release method on Mt. Kinada

	Date (1979)	New ids.	Mark ids.	Total	Mark ids. until the day before counting	Percentage of mark ids. to the total ids.
Pre-treatment census	Oct. 24	3	0	3	0	0%
	25	9	0	9	3	0
	26	8	2	10	12	2.0
	27	7	6	13	20	46.2
	28	9	11	20	26*	55.0
	29	11	9	20	35	45.0
	30	4	12	16	46	75.0
Laying poisonous baits (from the afternoon of Oct. 30th to the morning of Nov. 6th)						
Post-treatment census	Nov. 7	23	3	26	50	11.5
	8	12	4	16	47	25.0

*: One mark id. was killed in an accident.

calculated to have killed 86% of the marked voles. The two days' period of post-treatment census was indeed short. But, 35 voles, which were caught in these two days were un-marked individuals and commanded an absolute majority in the total catches. Most of these individuals were thought to be immigrants recovering the population as reported by KINOSHITA *et al.*[7] Therefore, around 86% of the population was thought to be controlled.

From the results of trials I and II, it can be concluded that the rodenticide 2-(diphenyl acetyl)-1, 3-indandione has a high effectiveness in the control of *Microtus montebelli* populations.

Acknowledgements

The author is grateful to Dr. K. KATAGIRI, Division of Forest Protection of the Forestry and Forest Products Research Institute, for reading and criticizing the manuscript and to Dr. M. UEDA, of the same Division, for his encouragement.

References

1) BENTLEY, E. W. : A review of anticoagulant rodenticides in current use. Bull. Org. mond. Sante' Bull. Wld. Hlth Org., **47**, 275～280, (1972)

2) DRUMMOND, D. : Rats resistant to warfarin. New Scient., **47**, 771～772, (1966)

3) DICE, L. R. : Methods of indicating the abundance of mammals. J. Mammal., **12** 376～381, (1931)

4) TANAKA, H. and H. SUGIYAMA : Stochastical consideration (2), on the subject of rodent population. Jap. J. Sanit. Zool., 5th annual meeting proceedings, (1953)

5) LINCOLN, F. C. : Calculating waterfowl abundance on the basis of banding returns. Circ. U. S. Dep. Agric. (118), May, (1930)

6) BAILEY, N. T. J. : On estimating the size of mobile populations from recapture data. Biometrika, **38**, 293～306, (1951)

7) KINOSHITA, E., M. UEDA, T. KUWAHATA and Y. SHIBATA : On the recovery of the population of field mice in the controlled area by poisoned baits. Jap. Forest. Soc. Hokkaido 2nd annual meeting proceedings, (1953)

日本産ハタネズミ *Microtus montebelli* MILNE-EDWARDS に対する抗凝血性殺鼠剤 2-(diphenyl acetyl)-1, 3-indandione の野外効果試験

北　原　英　治(1)

摘　　要

現在，ネズミ類の駆除法は多数あるが，殺鼠剤の使用による駆除法が最も効果のある方法とされており，数多くの種類の殺鼠剤が開発されている。しかし，屋外に生息する野ネズミ類の駆除においては，速効性を有することと中毒死したネズミの摂食による二次的中毒が起こりにくい点により，燐化亜鉛剤が最も普通に使用されている。殺鼠剤は麦粉，サツマイモ，米糠，ふすまなどに少量の魚粉などを混ぜて現地のネズミの好みに合わせた毒餌として用いることが多い。それ故，毒性が速効性のため燐化亜鉛剤について，二次的中毒は程度の差こそあれ避け難い問題である。また，摂食薬量が致死量に到らない個体は，この殺鼠剤を忌避する傾向を示すことも知られている。

本試験に供した 2-(diphenyl acetyl)-1, 3-indandione は従来野外の野ネズミ類駆除に，その効果が疑問視されてきた抗凝血性殺鼠剤の一種である。ネズミがこの種の殺鼠剤を数日間連続摂食すると血液凝固機能の喪失と内出血が起こり，死亡する。この殺鼠剤は前述の燐化亜鉛剤においてみられる忌避性と二次的中毒性をほとんど有しない。

本州と九州の森林において主要な加害種であるハタネズミ *Microtus montebelli* MILNE-EDWARDS を対象種として，千葉県印旛郡の利根川河川敷と，同じく千葉県富津市郊外にある鬼泪山において試験を行った。利根川河川敷においては 50×100 m（10 m 間隔にて 1 か所に 4 個のワナを設置—合計 200 個），鬼泪山においては 40×80 m（10 m 間隔にて 1 か所 2 個のワナを設置—合計 64 個）の試験区にて，記号放逐法を用いて調査した。まず，毒餌の配置（両区とも 1 か所 50 g）に先立ち，その試験区における野ネズミの生息状況を把握し，毒餌配置後再びワナ掛けを行い捕獲される記号個体の有無にて，殺鼠剤の駆除効果の検討を行った。

利根川河川敷において，毒餌配置前 7 日間のワナ掛けにより 411 頭の個体に記号付けを行い，配置後 3 日間のワナ掛けにより 183 頭の記号個体を捕獲した。それ故，この試験区における駆除効果は約 50% と計算される。一方，鬼泪山試験区においては，毒餌配置前のワナ掛けで 46 頭の個体に記号付けを行い，配置後記号個体を 7 頭捕獲したにすぎない。それ故，鬼泪山においては 86% の駆除効果をみた。

利根川試験区に生息するハタネズミは ha 当り 1,120 頭と計算され，異常なまでに高密度であった。この異常に高密度な個体群と，配置殺鼠剤の量が密度に比して過少であったことが，この区において 50% と低い駆除効果を示した主要な原因であると考える。一方，鬼泪山試験区では未記号個体の死体を発見することもしばしばであった。それらの死体は吻端に出血跡が認められ，明らかに本試験に供した殺鼠剤を喫食して死亡したものと考えられる。これらの事実は，供試殺鼠剤の高率駆除効果を裏付けるものであった。

以上，2 つの試験区においての結果から，2-(diphenyl acetyl)-1, 3-indandione は野外においても十分にその野ネズミへの駆除効果が期待できるものと思われる。

1980年 4 月30日受理

(1) 保　護　部