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Comparative Studies on the Application of the Zinc Phosphide Rodenticide against the Japanese Field Vole, *Microtus montebelli* MILNE-EDWARDS

By

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Summary : The poisonous effects of a rodenticide, zinc phosphide (1%), with three different dosages (200, 400 and 800 g per 0.4 ha) against the Japanese field vole, *Microtus montebelli*, were investigated in three areas. The control effectiveness of the rodenticide was estimated by the reduction in the vole density, and was shown to be proportional to the increasing dosage of the poison (47.6% in 200 g application area, 76.0% in 400 g and 86.7% in 800 g-area). However, the percentage (ratio) of the bait consumption to the total dosage at each area decreased : 53.7, 36.2 and 30.5%, respectively.

Judging from the dosage-effectiveness relationship, it should be concluded that the proper application dosage of zinc phosphide rodenticide (1%) is 400 g against 25 individuals per 0.4 ha.

Introduction

Rodents have been pests to mankind for a long time, especially concerning agricultural and forestry products. Accordingly, many rodent control techniques have been developed and extensively improved with[1)2)3)] using the rodenticide and without[4)5)] the rodenticide. But, in many cases, the rodent population has already become a considerable size by the time the damage is discovered. So rodent control must be conducted by using rodenticides which are quick and effective.

Zinc phosphide is the most popular and commonly used rodenticide in Japan. It has an acute toxicity because of its degradation to zinc oxide and phosphine (PH_3) in the presence of both alkalis or acids. The phosphine is the gaseous substance which kills the target rodent pest. Rodenticides must be used without any undue side effects such as environmental deterioration.

From the standpoint of decreasing the influences to wildlife, it is advisable to apply the proper dosage of rodenticide corresponding to the population density. This paper deals with the effectiveness of the rodenticide, zinc phosphide (1%), against the Japanese field vole, *Microtus montebelli* MILNE-EDWARDS, in relation to its population control.

Materials and methods

Trials were carried out on the western slope of Mt. Kinada located in the suburbs of Futtsu city in Chiba Prefecture, from October 24th to November 8th, 1979. This place is a good habitat for the Japanese field vole which is known to cause serious damage to forest trees in Honshu and Kyushu.

The population density was estimated through the mark and release method[6)] in three

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50 × 80 m areas before laying poisonous baits. Poisonous baits of 5, 10 and 20 grams in weight were laid at about 50 m intervals at the trapping points of these three areas and left for seven days. After this period, the bait remnants were fetched back to the laboratory, dried in an oven at about 50°C for over 24 hours and weighed with a balance.

The effectiveness of the poison treatment was estimated by the difference in the total number of marked voles captured before and after setting the poisonous baits. Live-traps were dispersed at 10 m intervals in a 50 × 80 m area.

The rodenticide used was zinc phosphide 1% and the target species in these trials was the Japanese field vole, *Microtus montebelli* MILNE-EDWARDS.

Results and discussion

Results of the mark and release method on each area are summarized in Table 1, 2 and 3, respectively. The population of voles in each area was presumed to be 21.5 Ids/0.4 ha on

Table 1. Results by the mark and release method on the 5 g-poison-treatment area

	Date (1979)	New Ids	Ids Marked	Total	Ids Marked until the day before counting	Percentage of Ids Marked to the Total Ids
Pre-treatment census	Oct. 25	10	0	10	0	0%
	26	9	6	15	10	40.0
	27	5	12	17	19	70.6
	28	2	12	14	24	85.7
	29	0	14	14	26	100.0
	30	4	10	14	26	71.4
Treatment with poisonous baits (from Oct. 30 afternoon to the morning of Nov. 5)						
Post-	Nov. 6	0	3	3	30	100.0
	7	2	1	3	27	33.3
	8	1	0	1	26	0

Table 2. Results by the mark and release method on the 10 g-poison-treatment area

	Date (1979)	New Ids	Ids Marked	Total	Ids Marked until the day before counting	Percentage of Ids Marked to the Total Ids
Pre-treatment census	Oct. 25	7	0	7	0	0%
	26	4	2	6	7	33.3
	27	3	8	11	11	72.7
	28	4	6	10	14	60.0
	29	6	8	14	18	57.1
	30	2	10	12	24	83.3
Treatment with poisonous baits (from Oct. 30 afternoon to the morning of Nov. 5)						
Post-	Nov. 6	1	2	3	26	66.7
	7	0	2	2	24	100.0
	8	1	2	3	22	66.7

Table 3. Results by the mark and release method on the 20 g-poison-treatment area

	Date (1979)	New Ids	Ids Marked	Total	Ids Marked until the day before counting	Percentage of Ids Marked to the Total Ids
Pre-treatment census	Oct. 25	10	0	10	0	0%
	26	9	6	15	10	40.0
	27	5	12	17	19	70.6
	28	2	12	14	24	85.7
	29	0	14	14	26	100.0
	30	4	10	14	26	71.4
Treatment with poisonous baits (from Oct. 30 afternoon to the morning of Nov. 5)						
Post-	Nov. 6	0	3	3	30	100.0
	7	2	1	3	27	33.3
	8	1	0	1	26	0

the area treated with 5 g of poisonous baits, 22.5 Ids/0.4 ha on the 10 g-area and 29.9 Ids/0.4 ha on the 20 g-area according to SUGIYAMA's method[7]. Since there is not a great difference among the population densities of these three areas, it may be significant to compare these three control effectivenesses against the voles. The control effectiveness on each area was calculated to be 47.6% on the 5 g-area, 76.0% on the 10 g-area and 86.7% on the 20 g-area. It was a matter of course that the control effectiveness on the 20 g-area was the highest, while that on the 5 g-area was the lowest. From these results, a sufficient control effectiveness could not be confirmed in the application of 200 g of rodenticide against 21 voles per 0.4 ha. The effectiveness in the application area of 400 g of rodenticide was almost same as that in 800 g rodenticide area.

FUJISHITA pointed out that the proper application dosage of zinc phosphide (3%) was 1.0 kg per 1.0 ha at the most, and that a retouching application would be more effective against a high density population[8]. The author agrees to this opinion that the rodenticide application with more than 1.0 kg/ha is not so effective against a high density population. On the other

○ 4.6	○ 1.9	○ 3.6	○ 2.3	○ 3.5	○ 5.0	○ 4.7	○ 4.0
○ 1.3	○ 1.9	○ 1.6	○ 2.0	○ 2.2	○ 4.7	○ 2.3	○ 3.5
○ 0.8	○ 0.7	○ 1.7	○ 4.3	○ 2.8	○ 4.7	○ 2.3	○ 2.5
○ 2.0	○ 1.4	○ 4.8	○ 2.0	○ 5.0	○ 2.5	○ 2.1	○ 2.7
○ 1.4	○ 0.9	○ 2.1	○ 2.2	○ 1.9	○ 3.9	○ 2.1	○ 1.6

grams

Fig. 1 The arrangement of the bait and the amount of its consumption by voles at each point on the 5 g-poison-treatment area.
107.5 g…Total consumption / 200.0 g…Total application (53.7%)

○ 5.2	○ 3.1	○ 5.2	○ 4.1	○ 4.7	○ 4.3	○ 10.0	○ 1.8
○ 2.3	○ 2.9	○ 1.5	○ 3.0	○ 3.7	○ 2.7	○ 1.6	○ 1.0
○ 3.2	○ 2.2	○ 4.4	○ 4.0	○ 3.9	○ 2.1	○ 2.0	○ 2.5
○ 3.1	○ 2.5	○ 8.8	○ 4.9	○ 1.7	○ 5.8	○ 2.4	○ 1.5
○ 3.6	○ 4.0	○ 5.4	○ 2.5	○ 2.9	○ 1.7	○ 10.0	○ 2.5

grams

Fig. 2 The arrangement of the bait and the amount of its consumption by voles at each point on the 10 g-poison-treatment area.
144.7 g…Total consumption / 400.0 g…Total application (36.2%)

○ 6.2	○ 4.8	○ 4.5	○ 7.2	○ 6.7	○ 5.8	○ 6.2	○ 4.2
○ 5.7	○ 9.2	○ 4.7	○ 6.0	○ 7.5	○ 7.9	○ 13.1	○ 15.5
○ 3.3	○ 9.4	○ 4.5	○ 6.0	○ 6.5	○ 4.8	○ 5.4	○ 4.3
○ 4.8	○ 3.9	○ 4.3	○ 5.1	○ 8.1	○ 5.3	○ 4.8	○ 4.3
○ 4.1	○ 5.6	○ 4.5	○ 4.5	○ 5.2	○ 7.7	○ 6.3	○ 6.2

grams

Fig. 3 The arrangement of the bait and the amount of its consumption by voles at each point on the 20 g-poison-treatment area.
$\frac{244.1\text{ g}\cdots\text{Total consumption}}{800.0\text{ g}\cdots\text{Total application}}$ (30.5%)

hand, Higuchi suggested that the standard application dosage, 0.5 kg/ha, could control a sufficient number of voles[9]. But, he did not have a full discussion on the consumption of baits and the population density.

The state of bait consumption by voles at each trapping point is shown in Fig. 1, 2 and 3. Marks of ○ in figures indicate the points where poisonous baits were laid, and the number under the marks shows the concrete consumption dosage (grams). The total consumption amount in the 5 g-area was smaller than that in the 10 g and 20 g-areas. But, in comparing the percentage of bait consumption to the application dosage, that in the 5 g-area was very high (53.7%) and remarkably difierent from the others, with 36.2% in the 10 g-area and 30.2% in the 20 g-area. In looking over the bait consumption at each point, that in the 20 g-area was the largest, approximately 5 to 10 g. The percentage of bait consumption to the total application in the 5 g-area was incredibly high in spite of the short period for laying poisonous baits. It seemed to be that the 5 g application at each point was too little against the number of voles inhabiting that area.

Judging from the data showing the control effectiveness and the percentage of bait consumption, it can be concluded that the proper application dosage of the rodenticide, zinc phosphide (1%), is 400 g against 25 Ids per 0.4 ha.

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日本産ハタネズミ *Microtus montebelli* MILNE-EDWARDS に対する燐化亜鉛1%剤の適正散布量に関する研究

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摘　要

一般に野ネズミの防除方法としては，はじきワナなどのワナ掛けによる機械的方法，食物連鎖などの生態系を考慮した生物学的方法および殺鼠剤による化学的方法があげられる。しかし，実際にはその効果の明瞭な殺鼠剤による防除方法が頻繁に行われている。

山林や草原において殺鼠剤による野ネズミ防除を行う場合，小麦やトウモロコシのような穀物の粒に殺鼠剤を混ぜて団子としたり，穀物の砕片に薬剤をまぶしたものを散布するのが普通である。そのための防除の対象となる野ネズミ以外の鳥獣が喫食する可能性もある。また，毒餌にて死亡した野ネズミを食肉獣が捕食することで発生するかも知れない二次毒性についても考慮しなければならない。

殺鼠剤の散布量は野ネズミの生息数に見合った量を散布することが，前述の野生鳥獣への影響を少なくすることから，また経済的な観点からも望ましいことである。本試験は，現在わが国の林野において広く使用されている燐化亜鉛剤を用いて，野ネズミの生息数に応じた毒餌の適正な散布量を検討し，その基準化を計る目的で行われた。

千葉県富津市郊外にある鬼泊山において，1979年9月24日から10月8日まで試験を行った。まず，50×80mの調査区画を3か所に設け，各区画では10m間隔の格子状に生け捕りワナの設置場所を定め，1か所に1個のワナを設置した（各区画—40個）。なお，毒餌としては，小麦粉を主成分に1%含有に調製された市販の燐化亜鉛剤を用い，これをワナ設置か所に配置した（各区画—40か所）。毒餌の配置に先立ち野ネズミの生息状況を記号放逐法にて調査し，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駆除効果の検討を行った。毒餌の喫食量については，各調査区画ごとに一定量（1か所当り5g，10gおよび20g）の毒餌を配置し，7日間放置後回収し，十分乾燥して重量の測定を行い喫食量を求めた。

各調査区での野ネズミの生息数は，杉山式の算出方法によるとha当り53.8頭（5g配置区），56.3頭（10g配置区）と74.8頭（20g配置区）であった。また各区の野ネズミの駆除率は，各々47.6%，76.0%と86.7%であり，さらに毒餌の喫食率（喫食量/配置量）は，各々，53.7%，36.2%と30.2%であった。駆除率の最も高い区画は20g配置区であるが，10g配置区でのそれとは，大きな差異は認められなかった。駆除率の最も低い5g配置区（47.6%）では，逆に最も高い喫食率をみたが，毒餌配置期間が7日という短かさにもかかわらず，53.7%の高い率の喫食率を示したことは，配置量の少なさを示していると考える。

野ネズミの生息数と森林被害の程度は必ずしも一致するものではないが，一般にハタネズミの場合，ha当り50～60頭になるとヒノキ，アカマツ，カラマツ幼齢林で40～50%の被害が見られるとされている。今回の試験の結果では，ha当り55頭のハタネズミに対して，燐化亜鉛1%剤のha当り1kgの散布で80%前後の駆除効果が期待でき，この量が適正な散布量をきめる場合の一つの基準になるものと考えられる。

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