EFFECT OF CALCIUM AND POTASSIUM ELEMENTS AND THEIR MIXTURE ON LAND SNAIL *EOBANIA VERMICULATA* (MULLER)

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Abstract

The present study aims to illustrate the role of each of calcium, potassium and their mixture (1:1) on some biological aspects of land snail *Eobania vermiculata* (Muller). The examined elements were added to snail food at three selected concentrations (0,5 , 1.0 , 1.5%) and the evaluated biological aspects include incubation period, hatchability rate and reproduction potention .

The obtained data revealed that the studied biological aspects were considerably affected and such affects clearly differed according to the type and concentration of the additives . The mixing of the two elements encourage the tested biological aspects comparing with the usage of them separately and the calcium element has the upper hand particularly at its low concentration . Moreover, the low concentration (0.5%) of calcium, potassium and their mixture was the most suitable for the tested biological items (incubation period recorded 19.62, 20.04 and 17.12 days , hatchability rate reached 95.90, 94.54 and 98.10 % and number of eggs/clutch were 111.4, 97.6 and 123.6 ,respectively) while the high concentrations (1.0 and 1.5%) resulted in an adverse effect as they drive land snail into shell for several days without feeding.

INTRODUCTION

Molluscs are important to man because of the damage they do in numerous agronomic, horticulture and ornamental plants. These animals cause serious yield reduction of infested crops and fruits, as well as destroying plant seedlings (Ghamry,1994).

Lack of calcium and potassium in the soil results; slow growth, high mortality, cannibalism and cessation of reproduction, also in young animals the wall of the shell becomes thinner than the normal ones because calcium carbonate is removed from the older parts of the shell so that it may be used for enlargement of the shell (Godan 1983). The advantages of calcium- rich enviroment for health, weight, longevity and fecundity (Crowell, 1973).

The present work aims to study the effect of certain concentrations of calcium and potassium elements on the biological aspects of land snail *Eobania vermiculata* (Muller) as well as their growth adutilization in IPM programme of Molluscs.

MATERIALS AND METHODS

1- Tested animals

Adults of land snail, *Eobania vermiculata* (Muller) (shell size 17-20 mm in diameter) were handly collected from the ornamental plants during autumn season 2005. All 10 healthy individuals were kept in separate plastic boxes (35x12x18 cm) containing optimal moist clay soil (8-1o cm height) and supplied with fresh green lettuce leaves as well as carrot and cucumber slices for two weeks for acclimatization .The boxes were coverd with muslin secured with rubber band to prevent snails from escaping, and kept under controlled laboratory conditions (20±1°c and 80% ±5 R.H) (Baker and Hawke, 1991).

2- Tested materials

Calcium 12% and potassium oxide 36.5% produced by international agrico company. Water solutions of calcium, potassium and equally mixture of them were prepared at concentrations 0.5.1.0 and 1.5%. Each concentration was prepared by diluting the appropriate amount of formulated product with water.

3- Performance

One cm^3 from each concentration was took by the pipette and distributed on the fresh green lettuce leaves of snails which replaced every two days until eggs laying (Baker,1991). Eggs were measured under a research microscope using the stage micrometer and the incubation period, hatchability percentage as well as fecundity were calculated, for each treatment.

The newly hatch of similar shell size (1.125 mm) and weight (0.260 mg) were transferred to a small plastic boxes (20x20x30 cm) after two weeks from hatching and maintained the same conditions. Monthly , the juveniles were measured of shell diammeter and body weight. The growth rates was counted until six months. Also, the relative of six months in diameter of shell and weight were calculated by

$$\text{Relative of six months (mm)} = \frac{\text{shell diameter individual after six months}}{1.125\ \text{mm}}$$

$$\text{Relative of six months (mg)} = \frac{\text{weight individual after six months}}{0.260\ \text{mg}}$$

Five replicates were used in each treatement. Wall of boxes were scrubbed with a sponge and tap water monthly to remove snails wastes and prevent small flies from reproducing in the detritus, while the lids terraria were changed approximately every four months when it becomes dirty. Rearing boxes were examined weekly (Staikou, *et al*/1990 and 1991).

RESULTS AND DISCUSSION

This work designed to clear the role of each calcium, potassium and their mixture on some biological aspects of the land snail *E.vermiculata* and the obtained data are compiled in tables 1,2 and 3.

1-Effect on egg measurements

Data shown in Table (1) declear that the tested concentrations of calcium or potassium didn't considerably affect the diameter and weight of eggs when added separately to foods . The diameter and weight of eggs were 3.36, 3.26, and 3.25 mm and 0.035, 0.033 and 0.030 mg in case of calcium addition and 4.02, 3.96, and 3.31 mm, and 0.035, 0.034 and 0.033 mg when snails diets treated with the three levels of potassium, respectively. The corresponding values in untreated snail diets were 3.10 mm and 0.033 mg. On the other hand when calcium and potassium mixed with 1:1 ratio the diameter and weight of eggs significantly increased to be 4.26, 4.2, and 3.64 mm,and 0.046, 0.042 and 0.041 mg for the three tested levels, respectively.

2- Effect on the other biological aspects

Other biological aspects associated with *E.vermiculata* snails including incubation period, hatchability percentage as well as number of clutch/snail and number of eggs/ clutch were studied under the same experimental conditions. The compiled data in Table (1) revealed that considerable decreases in incubation period of eggs were noted when snails were fed on fresh food treated with 0.5% calcium or potassium alone as eggs of untreated snails lasted 21.42 days in incubation period which decreased to be 19.02 and 20.04 days when snails were fed on diets mixed with 0.5% calcium or potassium alone, respectively. An adverse effects were observed with the high levels of the two elements (1.0 and 1.5%) as eggs of treated animal required 24.16, 26.12 and 23.84, 27.3 days to hatch for the two tested elements, respectively. On the other hand, when calcium - potassium mixtrue was mixed with fresh food at 0.5 and 1.0%, the incubation period was significantly decreased to be 17.12 and 19.12 days, comparing with that of untreated cheek which recorded 21.42 days,

Table 1. Effect of certain concentrations of calcium, potassium and their mixture on some biological aspects of land snail *Eobania vermiculata* under controlled laboratory conditions (20 ± 1°C & R.H. 80± 5%)

Item	*control*	*Calcium*			*L.S.D.*	*Potassium*			*L.S.D.*	*Calcium + Potassium*			*L.S.D*
		0.5%	1.0%	1.5%		0.5%	1.0%	1.5%		0.5%	1.0%	1.5%	
Diameter of egg (mm)*	3 .10	3.36	3.26	3.25	0.464	4.02	3.96	3.31	0.491	4.26	4.2	3.64	0.471
Weight of egg (mg)*	0.033	0.035	0.033	0.030	0.005	0.035	0.034	0.033	0.0044	0.046	0.042	0.041	0.0049
Incubation Period*	21.42	19.62	24.16	26.12	0.622	20.04	23.84	27.3	3.465	17.12	19.12	21.60	0.650
Hatchability %*	92.9	95.90	88.16	75.86	2.378	94.54	94.32	91.22	1.752	98.1	96.96	93.38	1.789
Number of clutch / snail*	3.0	3.6	2.8	2.4	0.711	4.0	3.6	3.2	0.562	4.0	3.6	3.2	0.562
Number of eggs / clutch*	87.9	111.4	85.8	77.0	6.774	97.6	93.0	83.8	11.109	123.6	117.0	94.8	7.774

*These values are the mean of five replicates

The high concentration (1.5%), however, almost didn't affect the incubation period of the control treatment (21.6 days).

Regarding to the effects of the examined concentrations on the egg hatchability percentages, the obtained data illustrated in Table (1) pointed out that the addition of calcium – potassium mixture to snail diets significanilty increased the hatchibility percentages of egg to be 98.1, 96.96 and 93.38% for 0.5,1.0 and 1.5% levels, respectively, in comparison with 92.9% for of the untreated check. This trend was observed when calcium or potassium was separatly mixed with snail diets at low concentrations as the coresponding hatchability rates were 95.90 and 94.54 % . On the other hand, the high levels of the two elements (1.0 and 1.5%) didn't significanitly affect this aspect particullary with calcium, since they resulted in hatchability rates of 88.16 and 75.86%for calcium and 94.32 and 91.22 % for potassium.

Also, data illustreated in Table (1) revealed that the low concentration of each of calcium , potassium and their mixture was suitable for egg laying as when snails were fed on 0.5% level of them, number of clutch per snail and number of eggs per clutch significanitly increased from 3.0 clutch/snail to 3.6, 4.0 and 4.0 and form 87.9 eggs / clutch to 111.4,97.6 and 123.6, respectively. The adverse effects on these paremters were considerably recorded with the high level of these elements (1.5 %) as their values were 2.4, 3.2 and 3.2 clutch / snail and were 77.0, 83.8 and 94.8 eggs/ cluth, respectively.

3- Effect on snails growth

Data in Tables (2 and 3) illustrate the effect of both calcium and potassium elements, separately or in combination, on the development of shell diameter and body weight of the treated snails. Regarding their effects on shell diameter, data shown in Table (2) revealed that a noticeable increase in shell daimeter of snails fed on the low level of both calcium and potassium alone and the all the levels of their mixture when meassured after one and two months from hatching .Therefor, when snails diet was mixed with 0.5% calcium or potassium, the shell diameter of snails aged one month was 4.58 or 4.4 mm while that of snails aged two months was 7.7 or 7.2 mm, respectively. The corresponding values for 0.5, 1.0 and 1.5% of calcium and potassium mixture were 5.4 , 4.9 and 4.28 mm,9.06, 8.36 and 7.54 mm for snails aged two months, In all cases, however, the shell diameter for snails of control treatment was 3.69 and 6.76 mm, respectively. On the other hand, shell diameter measuerments of snails aged six months did not considerably change when snails fed on potassium as ratio of increasing relative to newly

Table 2. Effect of certain concentrations of calcium , potassium and their mixture on the mean diameter of the shell of land snail *E.vermiculata* under controlled laboratory conditions (20 ± 1°C & R.H. 80± 5%)

Materials	Concentration %	Diameter of shell (mm) after*						Relative of six months (mm)*
		One month	Two months	Three months	Four months	Five months	Six months	
Control	-	3.69	6.76	8.03	9.92	12.01	14.39	12.8
Calcium	0.5	4.58	7.70	8.96	10.96	13.00	15.10	13.5
	1.0	4.10	7.04	8.02	10.26	12.18	14.90	13.3
	1.5	3.80	6.88	7.78	9.74	12.00	14.52	12.9
L.S.D		0.738	0.880	0.546	0.493	0.661	0.772	
Potassium	0.5	4.40	7.20	9.28	10.60	12.34	13.88	12.4
	1.0	3.62	6.24	8.22	10.58	11.84	13.62	12.2
	1.5	3.52	6.12	7.96	9.88	11.06	13.12	11.7
L.S.D		0.676	0.672	0.629	0.959	1.058	0.522	
Calcium + Potassium	0.5	5.40	9.06	11.82	13.24	15.18	16.30	14.6
	1.0	4.90	8.36	10.30	11.66	14.18	15.50	13.8
	1.5	4.28	7.54	9.76	10.24	11.74	14.62	13.1
L.S.D		0.618	0.982	0.834	0.801	1.063	0.895	

* The values shown in the table are the mean values of five replicates.

Table 3. Effect of certain concentrations of calcium, potassium and their mixture on the mean weight of land snail *E.vermiculata* under controlled laboratory conditions (20 ± 1°C & R.H. 80± 5%)

Materials	Concentration %	Weight of snail (mg) after *						Relative of six months (mg) *
		One month	Two months	Three months	Four months	Five months	Six months	
Control	-	2.62	3.15	8.92	19.10	35.23	50.92	195.8
Calcium	0.5	2.80	3.64	9.54	19.70	39.42	53.78	206.8
	1.0	2.64	3.14	9.00	19.02	37.50	50.46	194.1
	1.5	2.50	3.18	8.52	18.94	35.56	49.24	189.4
L.S.D		0.417	0.764	0.971	1.171	4.875	5.593	
Potassium	0.5	2.64	3.86	10.18	20.62	30.74	43.04	165.5
	1.0	2.34	2.98	8.86	17.1	28.76	39.58	152.2
	1.5	2.08	2.66	8.32	15.94	27.74	38.02	146.2
L.S.D		0.726	0.423	0.761	1.011	2.701	2.863	
Calcium + Potassium	0.5	4.70	8.14	16.46	28.70	38.76	54.50	209.6
	1.0	4.56	8.00	16.36	27.96	35.88	54.40	209.2
	1.5	3.84	6.08	15.16	25.9	35.70	51.8	199.2
L.S.D		0.534	1.139	1.250	2.467	6.729	5.443	

* The values shown in the table are the mean values of five replicates.

offsprings for control was 12.8 times, while for those fed on thee levels of potassium were 12.4, 12.2 and 11.7 times, respectively.

The low concentrations of calcium induced a noticeable increase in diameter shell of snails as these values reached 13.5 and 13.3 times for 0.5 and 1.0% levels, while only 12.9 times was recorded with 1.5% level. The increases of shell diameter of snails were obviously noticed when calcium and potassium mixed with food to be 14.6, 13.8 and 13.1 fold at the three levels, respecitively.

The same trend was observed with the effects of these elements on snails body weights as shown in Table (3). Body weight of untreated snails gradually increased from 2.26, 3.15, 8.92, 19.10, 35.23 to 50.92 mg when measured after 1, 2, 3, 4, 5 and 6 months, respectively with ratio of 195.28 times. On the other hand, when calcium was added alone to foods of snails, the increasing of body weight was obvious only with 0.5 level (206.8 fold), while its high level (1.5%) caused an adverse effect on the snail body weight compared with the control (189.4 fold). In the same time potassium element exhibited a considerable adverse effect on snails body weights when applied with the three tested levels as the ratio of its values after six months relative to the initial were 165.5, 152.2 and 146.2 folds, respectively. The opposite was observed when the mixture of both elements was added to the snails food at its three tested levels, i.e. 209.6, 209.2, 199.2 folds were recorded, respectively.

Discussing the aformentioned results, its cleared that the effects of these elements on the biological aspects of the snails when added to their food considerably differed according type and concentrations of these additivies as mixing of the two elements encourge the itmes of their biology and growths, while treatments of them alone have different effects as the obtained results revealed that calcium has the upper hand, particullary with low levels, on the development and the biological aspects of the snails.

Cobbinah and Osel-Nkrumah (1988) studied the growth rate of *Achatina achatina* as measured by snail weight and shell diameter. The four tested food stuffs were arranged in order of suitability. Thus, green pawpaw,cocoyum leaves, flam flower leaves and ripe palm fruits. They attributed differences in growth rates to a variety of factors within the food evaluated. Fouad (1999) reported that calcium contents in soil have vital importance to snail and slug and was a primary prerequisits for feeding and fecundity, while lack of calcium effects on slow growth, and it was show that 0.5 g of calcium was the most favourable level of calcium for rearing of snail, while 2.0 and 2.5 g calcium were the least ones.

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تأثير عنصرى الكالسيوم و البوتاسيوم و مخلوطهما علي قوقع الحدائق البني الكبير ***Eobania vermiculata***

مها فؤاد محمود ، عبد الموجود عبد الله عسران ، حسن إبراهيم الديب

معهد بحوث وقاية النباتات – مركز البحوث الزراعية ، الدقي – الجيزة.

تم تغذية الأفراد البالغة من القوقع علي كل من الكالسيوم والبوتاسيوم وخليط منهم بنسبة ١:١ثم تم متابعة إنتاج هذة الأفراد من عدد كتل البيض وعددالبيض في كل كتله وفترة حضانة البيض ونسبة الفقس ثم متابعة نمو هذا الفقس من حيث قطر الصدفة ووزن الجسم لمدة ست شهور.

وكانت النتائج كالتالي:

كان لخليط الكالسيوم والبوتاسيوم أهمية كبيرة في خفض فترة حضانة البيض وزيادة كل من إنتاج البيض ونسبة الفقس وحجم ووزن البيض بصورة أكبر مما كانت عليه عند التغذيه علي الكالسيوم والبوتاسيوم كل علي حده وذلك إذا ما قورن بتجربة المقارنة .

كذلك أعطي التركيز ٠,٥% أفضل النتائج في حالة الكالسيوم والبوتاسيوم والخليط منهم حيث كانت فترة حضانة البيض ١٩,٦٢ و٢٠,٠٤ و١٧,١٢ يوم وكانت نسبة فقس البيض ٩٥,٩ و٩٤,٥٤ و٩٨,١٠% على التوالي، أيضا كان أعلى إنتاج للبيض ١١١,٤ و٩٧,٦ و١٢٣,٦ بيضة/ كتلة لنفس التركيز على التوالي بينما التركيزات الكبيرة (١,٠ ، ١,٥%) كانت اقل تاثيراً حيث كان لهذه العناصر تأثير طارد للقواقع حيث أدت إلى اختفاء القواقع داخل الصدفة لمدة طويلة بدون تغذية مما أثر علي إنتاجها.

كذلك لم يتأثر وزن الجسم وقطر الصدفة كثيرا بهذه العناصر حيث كان الاختلاف بسيطاً وغير معنوي.