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Full Length Research Paper

Influence of stocking rate on growth and reproductive performance of breeding snails (*Archachatina marginata*)

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It has been established that performance of livestock is affected by stocking density. Overcrowding has been found to have negative effects on growth and reproductive performance hence, this study was conducted to establish appropriate stocking density for breeding snails. A total of two hundred and twenty-five breeding African giant land snails (*Archachatina marginata*) without shell damage were selected for this trial which lasted 6 months. The snails had an average live weight of 437.41 ± 11.56 g. They were randomly allotted to 5 different treatments T_K, T_L, T_M, T_N T_O, with stocking rates of 5, 10, 15, 20 and 25 snails per square metre, respectively. Each treatment was replicated thrice in a completely randomized design. Feed intake, weight gain, shell length and width were measured while reproductive parameters in terms of number and weight of the eggs collected, incubation period and mean weight of the hatchlings at day old were also taken. The results showed no significant ($P > 0.05$) differences in mean feed intake and weight gain in T_K, T_L, and T_M while the lowest mean feed intake and weight gain were recorded in T_o stocked at 25 snails per square metre. There were no significant differences in the mean monthly shell length increment ($P > 0.05$). The highest mortality of 25.3% was recorded in T_O stocked with 25 breeding snails per square metre. The highest mean total egg collection of 32.61 eggs was recorded in T_K which was relatively the same with T_L, T_M and T_N ($P > 0.05$). The mean weight of the eggs were relatively the same ($P > 0.05$) in T_K, T_L , T_M and T_N . The lowest mean egg weight was recorded in T_o. It could be concluded that one metre square apartment could house up to 15 breeding snails without any adverse effect on growth, reproduction and state of health of the breeding snails.

Key words: Egg size, hatchling's weight, Nigeria, snails, stocking rate, weight gain.

INTRODUCTION

Snails are invertebrate, shell bearing animal that are passive or inactive during the day, but very active in the night, at dusk or when it rains. They are usually found in cool environment. (Amusan and Omidiji, 1999; Omole, 2001). Snail farming in Nigeria had been given little attention until recently when the price of protein of animal origin became too expensive for an average Nigerian. In the rainforest belt of the South Western Nigeria, snail meat is a delicacy that is relished and highly priced (Akegbejo and Akinnusi, 2000). In traditional African medicine, snail meat is used in the preparation of concoctions for various cases such as reduction of labour pains and blood loss in pregnant women during delivery (Akinnusi, 1998; Amusan and Omidiji, 1999). The non-edible visceral parts of the snail can be processed and used as source of protein to replace fish in livestock diet. Snail farming does not require much land space for establishment, expenses on management is low compare to other conventional livestock and it is a good earner of foreign exchange (FAO, 1986). The shell which constitutes about 30% of the body live weight can be used as a good source of calcium (Bright, 1996). The major fac-

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Table 1. Proximate composition of leaf and fruit of pawpaw (% dry matter basis).

%	Pawpaw fruit	Pawpaw leaf
Dry matter	9.81	14.56
Crude protein	8.41	22.38
Crude fiber	5.80	6.45
Ash	7.21	6.95
Ether extract	1.34	1.23
Nitrogen free extract	72.24	62.99

tors affecting performance of animals in terms of growth and reproduction are proper feeding, breeds, disease control and optimum stocking density etc. In poultry, there is increase in rate of disease spread, cannibalism and the number of birds culled increased when birds are densely packed; also there is depression in feed consumption and final body weight at higher stocking density (Derlugyan et al., 1975; Agunbiade and Benyi, 1988). Ayodele and Asimalowo (1999) reported that the amount of eggs laid and frequency of laying is reduced at higher stocking rate in snail production. Several authors have suggested stocking rates without scientific proof (Akinnusi, 1998; Bright, 1996; Amusan and Omidiji, 1999). However, farmers are complaining of slow growth and high mortality which could be as a result of over-population, hence this trial was conducted to establish the appropriate stocking rate for the breeding snails.

MATERIALS AND METHODS

The experiment was carried out at the Snailery Unit of the Institute of Agricultural Research and Training (I.A.R.T.), Moor Plantation, Ibadan which is located on Longitude 03°51E, Latitude 07°23N and Altitude 650” lies in the humid zone of the rainforest belt 0703.25 of South Western Nigeria with mean annual rainfall of 1220 mm and mean temperature of 26°C.

System of rearing

The snails were reared under intensive system of production using cages. Trees were planted around the house which made the environment cool.

Cage

The cage used for the experiment was built of wood and wire netting. The bottom of the cages were perforated to allow free drain of water when wetting the soil. The top was built of mosquito netting reinforced with wire mesh. The stands of each cage were put inside a container filled with used engine oil to prevent soldier ant infestation.

Soil

Sandy loam soil was collected from the Southern Farm of the Institute and used as bedding for the snails inside the cages.

Sources of experimental animals

The snails (*Archachatina marginata*) were purchased from the snail farmer in Ibadan.

EXPERIMENTAL DESIGN

A total of two hundred and twenty-five breeding African giant land snails (*A. marginata*) without shell damage were selected for trial which lasted 6 months. The snails had an average live weight of 437.41 ± 11.56 g. They were randomly allotted to 5 different treatments T_K, T_L, T_M, T_N T_O with stocking rates of 5, 10, 15, 20 and 25 snails per square metre, respectively. Each treatment received 3 replicates in a completely randomized design. T_K was used as control as suggested by Amusan et al. (1998). The snails were reared in raised wooden cages of one metre square compartments.

Parameters measured

The feed and water were served inside flat trays. Wetting of the soil was done on daily basis with the use of a watering can. The fruits were cut into small pieces while the leaves were chopped and offered to snails *ad libitum* in each tray. The parameters measured were dry matter feed intake, weight gain, shell length, width and thickness. Feed intake and weight gain were measured on daily and weekly basis respectively with the use of electric weighing balance. The shell length and width were measured with vernier caliper while micrometer screw gauge was used to measure the shell thickness. Reproductive parameters in terms of number and weight of the eggs collected, incubation period and mean weight of the hatchlings at day old were also taken. An artificial incubator was designed to provide conducive environment for developing embryo. The incubator was built of wood with top covered with mosquito net reinforced with wire netting. The bottom was perforated to prevent water logging. The proximate composition of the experimental diets and excreta were carried out according to the method of AOAC (1990), while data were analyzed using SAS (1995).

RESULTS

The results of chemical analysis of leaf and fruit of pawpaw is shown in Table 1. The crude protein and fibre contents were relatively similar to the report of Bright, 1996 and Amusan and Omidiji, 1999.

Feed intake

There were significant differences in the mean monthly feed intake of the breeding snails ($P < 0.05$). However,

Table 2. Growth performance of breeding snails (*A. marginata*) under different stocking density.

Parameters	Stocking rate/m^2					
	T_K 5	T_L 10	T_M 15	T_N 20	T_O 25	±SEM
Mean monthly feed intake (g/snail)	143.72^a	145.42^a	140.50^a	119.80^b	100.80^c	10.58
Mean initial live weight (g/snail)	439.13^a	436.18^a	438.41^a	434.11^a	436.99^a	15.42
Mean final live weight (g/snail)	487.97^a	484.72^a	486.77^a	452.89^b	451.51^c	10.94
Mean monthly weight gain (g/snail)	8.14^a	8.09^a	8.06^a	3.13^b	2.42^c	0.71
Mean monthly shell length increment (mm)	2.41^a	2.41^a	2.38^a	2.37^a	2.37^a	0.31
Mean monthly shell width increment (mm)	1.91^a	1.90^a	1.89^a	1.89^a	1.87^a	0.08
Mean monthly shell thickness increment (mm)	0.10^a	0.10^a	0.11^a	0.10^a	0.11^a	0.05
Mortality %	0.00	0.00	0.00	13.30	25.30	
Mean feed conversion ratio	17.66^c	17.98^c	17.43^c	38.41^b	41.65^a	5.68

Means with different superscripts in the same row are significantly different ($P < 0.05$).

the mean monthly feed intake between T_K and T_M were relatively the same. The highest mean monthly feed intake of 143.72 g/snail was recorded in T_K while the lowest mean monthly feed intake of 100.8 g was recorded in T_O stocked at 25 snails per square meter (Table 2).

Weight gain

The weight gain in all the treatments were generally low. There were however significant differences in the mean monthly weight gain ($P < 0.05$) as shown in Table 2. The weight gain increased as the stocking rate decreased from 25 to 5 snails per square meter.

Shell length, width and thickness

There were no significant differences in the mean monthly shell length increment ($P > 0.05$). The values ranged between 2.37 mm in T_O to 2.41 mm in T_K. Meanwhile the shell width and thickness of the breeding snails too were not significantly affected by the stocking density of the snails.

Mortality

The highest mortality of 25.3% was recorded in T_O stocked with 25 breeding snails per square meter. No mortality was recorded in either T_K and T_L (Table 2) indicating that stocking density had a significant effect on the health status of the snails. ($P < 0.05$).

Reproductive performance

The result in Table 3 shows a significant difference in the mean total number of eggs collected from each treatment ($P < 0.05$). The highest mean total egg collection of 32.61 eggs was recorded in T_K which was relatively the same with T_L, T_M and T_N ($P > 0.05$). The lowest mean total egg collection of 8.15 eggs was observed in T_O. The mean weights of the eggs were relatively the same ($P > 0.05$) in T_K, T_L, T_M and T_N. The lowest mean egg weight was recorded in T_o. The mean incubation period ranged between 31.8 to 32.51 days ($P > 0.05$) and were relatively similar in all the treatments. The weight of the hatchlings at day old followed the same trend with that of egg weight of the snails. No significant differences were observed in shell length, width and thickness of the hatchlings at day-old ($P > 0.05$).

DISCUSSION

The low feed intake recorded at higher stocking rate could be attributed to over population which did not allow the snails free access to feed. Elmislie (1992) reported that the performance of snails in captivity is suppressed when their social structures and environments are altered. Moreover, Derlugyan et al. (1975) observed similar result of low feed intake when broilers were stocked at high stocking rate. The low weight gain recorded in all the treatments could be due to the effect of age on the snails since the snails were advanced in age. Moreover, Amusan and Omidiji (1999) reported that snails are slow growing animals. Ayodele and Asimalowo (1999) also reported that the performance of snails are affected by space and number.

At higher density, the growth is slower and the breeding is hindered. The retardation of growth with increasing population could be attributed to restrict access to feed and water. The similarity in values of shell length, width and thickness in all the treatments could be as a result of the old age of the snails in which the snails had developed hardened shell mouth which marked the termination of shell growth and development (Stievenart, 1992; Amusan and Omidiji, 1999). The shell growth in this experiment was lower than what was reported by

Table 3. Reproductive performance of breeding snails (*A. marginata*) under different stocking rate.

Parameters	Stocking rate/m^2					
	$T_{K\ 5}$	$T_{L\ 10}$	$T_{M\ 15}$	$T_{N\ 20}$	$T_{O\ 25}$	±SEM
Mean total eggs collected	32.01[a]	31.60[a]	31.58[a]	19.29[c]	8.15[d]	3.56
Mean weight of the eggs (g)	4.80[a]	4.78[a]	4.81[a]	4.76[a]	4.11[b]	0.32
Mean incubation period (days)	31.90[a]	32.40[a]	31.80[a]	32.51[a]	32.18[a]	2.89
Mean weight of hatchling (g)	4.10[a]	4.00[a]	4.11[a]	4.10[a]	3.41[b]	0.34
Mean shell length of the hatchling (mm/day-old)	13.21[a]	13.20[a]	13.24[a]	13.20[a]	13.26[a]	1.21
Mean shell width of the hatchling at day-old (mm)	11.15[a]	11.28[a]	11.22[a]	11.19[a]	11.18[a]	2.14
Mean shell thickness of the hatchling at day-old (mm)	0.35[a]	0.34[a]	0.34[a]	0.33[a]	0.34[a]	0.06

Means with different superscripts in the same row are significantly different. ($P < 0.05$).

(Hamzat, 2004) and this could bedue to the fact that the snails used in this study had reached terminal shell growth and development due to age of the snails. The zero mortality recorded in T_K, T_L and T_M could be due to proper ventilation, less compe-tition for feed, water and space while poor ventilation, cannibalism and increase in disease spread as a result of overcrowding could have resulted in higher mortality recorded at higher stocking rate (Hansen and Becker 1980). The lowest mean total eggs collected was recorded in T_o could be as a result of overcrowding.

Ayodele and Asimalowo (1999) reported that the amount of eggs laid and the frequency of laying is reduced at higher stocking rate. The mean weight of the hatchlings in all the treatments were higher than the mean live weight of 2.3 g at day old reported by Akinnusi (1998) and this could be attributed to large size of the snails used in this study. It was reported that the size of the hatchlings produced has positive correlation with the size of the snails (Amusan and Omidiji, 1999).

Considering the results on weight gain, efficiency of feed utilization and zero mortality recorded in T_M and the fact that the mean total egg collection was the same in T_K, T_L and T_M, it could be concluded that one metre square cage could house up to 15 breeding snails without any adverse effect on growth, reproduction and state of health of the breeding snails.

REFERENCES

Agunbiade JA, Benyi K (1988). Effects of stocking rate on the performance of two hybrids. Nig. J. Anim. Prod. 13: 112-118.

Akegbejo S, Akinnusi O (2000). Effects of population density on the growth and egg laying capacity of the African giant land snail (A. marginata). Niger. J. Anim. Prod. 27: 99–103.

Akinnusi O (1998). Introduction to snails and snail farming. Omega Science Publisher, Tinuose House, Lagos, Nigeria p. 153.

Amusan JA, Omidiji MO (1999). Edible Land Snail: A Technical Guide to Snail Farming in the Tropics. Verity Printer Limited, Ibadan pp. 5-50.

Association of Official Analytical Chemist (A.O.A.C.) (1990). Official Methods of Analysis, 13th Edition, Washington, D. C.

Ayodele IA, Asimalowo AA (1999). Essentials of snail farming. Agape Printers, Ibadan pp. 7-37.

Bright SO (1996). Prospects and problems associated with snail farming. Heritage Printers Nig. Ltd., Lagos p. 96.

Derlugyan EI, Bratskikh VG, Misikov II, Lushkina ZI (1975). The effectiveness of raising broilers at different stocking. Anim. Breed. Abstract 47:129.

Elmslie LJ (1992). Snail and Snail Farming. World Anim. Rev. 41: 20-26.

FAO (1986). Farming Snails by FAO Better Farming Series, 3/33 Rome, Italy.

Hamzat RA (2004). Utilization of testa (*Cola nitida*) in the feeding of African giant land snail (*Archachatina marginata*) in Southern Nigeria Nigeria. Ph.D Thesis, Department of Animal Science, University of Ibadan.

Hansen RS, Becker AN (1980). Feeding space, Population Density and Growth of Young Chickens. Poult. Sci. 39: 654-661.

Omole AJ (2001). How to start and manage Snail Farming. A paper presented at workshop organized by Petroleum Staff Training Programme for Retiree at Petroleum Training Institute Effunrun Warri, Delta State on March 13-15th 2001.

SAS (1995). S.A.S. User's Guide. Statistical Analysis System Institute, Inc.Cary, N.C.

Stievenart C (1992). Observations on shell lip formation and reproduction in the giant African Snail (*A. marginata,* S). Snail Farm. Res. 4: 20-29.