Influence of Media Mixture on Egg Hatchability of African Giant Land Snail (*Archachatina marginata* (Swainson): Implication for a Sustainable Biodiversity Conservation and Food Security.

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Abstract
The study assessed the influence of media mixtures on the hatchability of African Giant Land Snail eggs. Mature snails were managed properly to facilitate effective mating for egg production. Incubating media mixture was prepared using sharp sand (ShSa), fine sand (FiSa) and sawdust (SaDu) combined in volume v/v/v ratio viz: Treatment one (Trt1, 1:2:1); Treatment two (Trt2, 1:2:1); Treatment three (Trt3, 1:1:2); and Treatment four (Trt4, loamy soil) which served as control. Eggs laid were incubated in the media mixtures inside a wooden box in three replicates. The whole experimental unit was arranged using a Completely Randomised Design (CRD) in the laboratory. Data were collected on the number of eggs incubated, hatchlings picked 35 days after incubation (DAI), percentage hatchability, mean weight of hatchlings, and water holding capacity of the media. Data collected were transformed and analysed with ANOVA using SPSS version 21 and the means separated using Duncan Multiple Range test (DMRT) at 0.05 level of significance. The results revealed that there was a significant difference (P≤0.05) in the hatchability ($95.14^{a} \pm 4.34$); ($80.00^{a} \pm 9.10$) as influenced by the substrates, as well as water holding capacity of the substrates ($154.00^{a} \pm 4.00$), and treatment two (Trt2, 1:2:1) recorded the highest. It was concluded that a mixture of sharp sand, fine sand, and sawdust could influence the hatchability of snails' eggs. The study therefore recommends that media mixture treatment two could be adopted and used by snail entrepreneurs for viable snail farming to boost food security as well as sustainable biodiversity conservation.

Keywords: Snail, hatchlings, incubation, Media mixture, Biodiversityÿ conservation

Introduction

Snail is a bioresources that support the diet of both rural and urban populace. Snail is one of the bioresources that had from time immemorial been scavenged for in the bush by both old and young individuals. It is a good source of diet most especially for old men and women. Snail production has been confirmed as a bioenterprise that yields higher returns per capital investment (Munouye and Moses, 2019). The population of snails keeps decreasing due to deforestation, bush burning, use of chemicals, therefore, subjecting the ecosystem to disequilibrium, loss of biodiversity, and the animal to extinction (Eboua *et al*., 2010). In the wild, snails lay their eggs in loamy soil, and this accounts for the numbers being scavenged for and exploited by humans for nutritional and other purposes.

In snail farming, the common practice includes the collection of topsoil to be used as bedding material. Aside from destroying the edaphic terrains, this is not culturally acceptable. Conversely, eroded soil 'sand', and sawdust are free for usage. The report of Awohouedji *et al*. (2014) confirmed that sawdust is a good substrate for the breeding of Giant African land snails. Several research efforts have reported on the use of media for hatching snail eggs. The use of sawdust alone has been reported to be unsuitable material for hatching eggs of snails, but could be a better micro-habitat for the growth of hatchlings (Amata, 2014). Moreover, the use of absorbent cotton has been regarded as a good substrate for incubating *Achatina fulica* because of its ability to conserve (Deji *et al*, 2011), but the occurrence of fungi contamination cannot be ruled out in the use of these substrates (Awohouedji *et al*., 2014).

Eggs buried in loamy soil at a 3 cm depth with 15% water content facilitate good hatching. However, higher hatchability is assured with increased water uptake after 15 days of incubation (Ebenso 2006; Ugwu *et al*., 2011). According to Ibom *et al*. (2012), the optimum incubation period of 29 ± 1.48 days is appropriate for black-skinned pure breed *A. marginata*, while Ogogo (2004), reported that the incubation period for black-skinned *A. marginata* ranged between 29 and 32 days. Topsoil and river sand, as submitted by Amata (2014), are good micro-habitats for the hatching of *A. marginate* eggs, but continuous scraping of topsoil may be disadvantageous and may potent an ecological danger to crop production and food security.

Similarly, sustainability in the use of river sand may not be achievable due to the risk attached to the collection for commercial snail farming. Snails in their natural habitat lay eggs in soil, which is composed of sand, silt, clay, and organic matter in different proportions. Each of these components tends to perform a supportive role for snails' egg hatching. There is a dearth of information on the impact of the combination of sharp sand and sawdust substrates for snail egg incubation. It is against this background that this research was conceptualised and conducted to evaluate the effect of sharp sand (ShSa), fine sand (FiSa), and sawdust (SaDu) mixture on hatchability of the African Giant land snail (*Archachatina marginata*).

Materials and Methods

Pen Preparation: The snail pen used for the research was cleaned, and new substrate, 'wood shavings', were packed as bedding material. It was moistened before

introducing to the pen. Matured snails were collected from a snail pen in the snailry unit of Bioresources Development Centre (BIODEC) Owode Yewa South. The snails were washed with clean water and introduced into the pen in even numbers with a minimum of 10 in each pen.

Constitution of Incubation Media Used: Eroded sand was collected from the roadside and sieved into sharp and fine sand while sawdust was collected from the nearest sawmill industry. Loamy soil used as a control was collected from under a cocoa farm in a village in Oke-odan, a town closer to the centre. The eroded sand and sawdust used as treatments were constituted in a definite ratio by volume, sterilised with the use of hot water and sundried for 4-5 days prior to use. In volume (v/v/v) ratio, Treatment Trt1 consisted of 2:1:1, Trt2 (1:2:1), treatment Trt3 1:1:2 of sharp sand (ShSa), fine sand (FiSa) and sawdust (SaDu) mixture while treatment Trt4 was loamy soil which served as control.

Feeding and Management: Feeding was provided ad libitum with pawpaw fruit and leaves, watermelon, sweet potato fruit and leaves, cassava, and riped palm fruit, the pens were routinely sprinkled with grounded bone meal. Leftovers were removed after 2-3 days and replaced with fresh feed. Water was sprinkled on the feed and the substrate at 3-day intervals. Faeces were removed and the substrate was pulverised on a routine basis.

Management of Incubator and egg collection: Each incubator was covered with a plastic net reinforced with a rubber band to avoid the escape of the young snail after hatching. The incubator was watered moderately with an equal volume of water of 40cl every 3 days to ensure that adequate moisture was provided. The pens were checked daily and the total number of eggs laid were picked with a plastic spoon and buried at 3cm depth on each treatment packed in wooden boxes used as an incubator.

Collection of Hatchlings: The number of hatchlings was counted and weighed with a sensitive balance in grams 35 days after incubation (DAI).

Water Holding Capacity of Substrate Combination as Treatment: The water holding capacity of the (WHC) of the media mixtures was carried out in the laboratory. 250 ml measuring cylinders were used. Equal treatments were measured by volume and placed in the funnel stocked with cotton wool, and 250 mL of water was added and allowed to drain for 24 hours, after which the drained water levels were taken and recorded. Thereafter, the percentage water holding capacity of each treatment was calculated.

Experimental Design: There were four (4) treatments which were replicated thrice making a total number of 12 experimental units for the whole experiment and were laid out using Completely Randomised Design (CRD).

Data Collection: Data were collected on the number of eggs hatched by counting. The percentage hatchability and water holding capacity of the treatments were calculated as:

Percentage hatchability= $\frac{Number\ of\ Eggs\ hatched}{Number\ of\ Eggs\ Incubated}\ x\ 100$

Water holding capacity =Volume of water used - Volume of water drained

Data Analysis: Data on the number of eggs incubated, and the number of hatchlings picked after 35 days of incubation were transformed using square root transformation while the percentage hatchability was transformed using arcsine transformation before analysis. All the original and transformed data were subjected to ANOVA using SPSS version 21 and the means were separated using (DMRT). Both the original and transformed data were reported using parallel methods on each parameter respectively.

Results and Discussion

Percentage Hatchability of Incubated Eggs: As shown in Table 1 below, there was a significant (P≤0.05) difference in the percentage hatchability of the incubated eggs with the highest percentage (95.14 ± 4.34) recorded on treatment two on original data while the transformed data, (80.63^{a} ± 16.24) was recorded as highest on treatment three. The implication is that treatments two and three could have provided a conducive environment for the egg towards hatching.

Table 1: Percentage Hatchability of Incubated Eggs

Treatments	Original data	Transformed data
Trt_1 (2 ShSa: 1 FiSa: 1 SaDu)	50.00^{b} ± 28.87	44.53^{b} ± 17.69
Trt_2 (1 ShSa: 2 FiSa: 1 SaDu)	95.14^{a} ± 04.34	80.00^{a} ± 09.10
Trt_3 (1 ShSa: 1 FiSa: 2 SaDu)	92.59^{a}±12.83	80.63^{a} ± 16.24
Trt_4 (Loamy soil) control	80.30^{ab}±19.03	15.16^{ab} ± 13.31
Mean	79.51	67.47
C.V (%)	23.35	21.43
F-value	3.732	4.072
P-value	0.061	0.050
SEM	344.7	209.1

Means with the same superscript along the same column are not significantly different at 0.05 significant level using the Duncan Multiple Range Test Procedure (DMRT), SEM - Standard error of the Mean

Weight of Hatchlings: In Table 2, there was no significant (P≥0.05) difference in the weight of hatchlings picked. However, the highest weight of 2.11a ± 0.41 was recorded in treatment two. This implies that treatment two provided a good ecosystem for the hatchlings, probably in terms of water or sawdust for feeding.

Table 2: Mean Water Holding Capacity of the Media Mixture and Mean Weight of Hatchlings Picked.

Treatments	The mean weight of hatchlings	Water holding capacity of media mixtures
Trt_1 (2 ShSa: 1 FiSa: 1 SaDu)	1.69^{a} ± 0.89	109.33^{d}± 3.06
Trt_2 (1 ShSa: 2 FiSa: 1 SaDu)	2.11^{a} ± 0.41	154.00^{a} ± 4.00
Trt_3 (1 ShSa: 1 FiSa: 2 SaDu)	1.84^{a} ± 0.22	118.67^{c} ± 5.03
Trt_4 (Loamy soil) control	1.98^{a} ± 0.24	136.0^{b} ± 4.00
Mean	1.905	129.5
C.V (%)	27.52	3.15
F-value	0.355	69.993
P-value	0.787	0.000
SEM	0.275	16.67

Means with the same superscript along the same column are not significantly different at 0.05 significance level using the Duncan Multiple Range Test Procedure (DMRT), SEM - Standard error of the Mean.

Water Holding Capacity of the Media Mixture: Table 2 reveals that there was a significant (P≤0.05) difference in the water holding capacity of the media mixtures. Treatment two recorded the highest with a mean value of 154.00a ± 4.00 followed by treatment four 'loamy soil". This means that treatment two holds an optimum amount

of water that perhaps facilitates the effective hatching of the eggs.

Conclusion and Recommendation

The findings concluded that treatment two showed more influence on the parameters measured as an eco-friendly protocol for snail egg incubation. It is therefore recommended that sharp sand, fine sand, and sawdust mixture in a definite ratio by volume (2:1:2) could be used as incubating media for African Giant snail egg production.

Declaration of interest

The authors declare no conflict of interest.

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