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Effects of Different Soil Treatments on Weight Gain, Shell Length and Shell Aperture of Snails (*Archachatina marginata*)

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Abstract: Effects of different soil treatments on the weight gain, shell length and shell aperture of snails raised under standard condition were studied using 180 juvenile snails of similar weights. The snails were randomly assigned into four treatment groups designated as A, B, C and D and NPK fertilizer, Magnesium sulphate and Poultry manure were added at the rate of 1.5 kg/5 kg soil sample to treatments A, B and C, respectively, while treatment group D were placed in untreated soils. The experiment lasted for 176 days, during which the snails were subjected to similar dietary reign and husbandry practices. Data obtained were subjected to ANOVA under a completely randomized design and differences between means were separated using Least Square Significant Difference (LSD). The result show that snails raised on soil treated with poultry droppings performed better in all the parameters studied, followed by those raised in magnesium sulphate treated soil and the least being those raised on NPK treated soil. The study maintained that soil treatment affects snails' performance and recommends treatment of soil with poultry droppings to enhance snail production and discourages the use of NPK fertilizer in a land where the snail population is importance.

Key words: Soil treatments, weight gain, shell length, aperture

INTRODUCTION

Archachatina marginata belongs to the Phylum *Mollusca* and Family *Achatinidae* (Swainson, 1821). Except for insects, mollusca are the largest invertebrate group in the animal kingdom (Yoloye, 1994). *Archachatina marginata* are bilaterally symmetrical invertebrates with soft segmented exoskeleton, inhabiting mostly marine environments, tolerating varied environmental conditions and thrive best in temperate and tropical areas, where soil pH ranges from 4.5-8.0 (Adediran *et al*., 2003).

Various agricultural/ agronomic inputs such as mineral fertilizers, organic manure, herbicides and pesticides are used with the ultimate aim of maximizing productivity and economic returns (Averahami *et al*., 2003; Adediran *et al*., 2003), but the side effects on soil organisms are often neglected. Laboratory incubation, pot experiment and sampling of paired sites have been used to investigating the effect of mineral fertilizer on soil microorganisms, however, literature reports on effect on macro organisms like snail are scarce.

Nutritionally, snails are of paramount important as source of balanced and high profile protein, low in fat and rich in iron food ideal for human nutrition especially for diabetic patients (Cobbinah, 1993; Awah, 2000). Imebvore (1990) reported that snail meat compares favourably with whole egg in all essential amino acids especially with regard to lysine, leucine, isoleucine and phenylalanine. It is also rich in iron (Ajayi, 1980), low in fat (Cobbinah, 1993) and other trace minerals. Thiocalcium phosphate from snails exhibit some measure of curative effects on kidney disease, tuberculosis, anaemia, diabetes, asthma, ureticaria, circulatory disorder, constipation, hemorrhoids; it prevents influenza, restores virility and perpetuates beauty by clearing the skin (Mead, 1961; Awah, 2000). Snail farming is a lucrative business in most part of the world. However while some farmers in Asia and Europe have developed a technology for soilless snail farming, in Nigeria and most part of Africa snails are raised mainly in soil medium.

Farmers generally, use garden soil for snail rearing without any consideration on the effect of different soil treatments on the growth and performance of their snails. Cobbinah (1993) reported that soil texture and chemical composition of the soil affect the growth and shell development of snails. According to him, snails thrive better in soils that are rich in organic matter. Kari (2000) noted that poultry manure is rich in organic matter as it contains an average of 30 kg nitrogen, 41 kg phosphorus and 34 kg potassium per tonne. Ange (1994) cited in Sansoucy *et al*. (1995) reported that cattle dung contain 8 kg nitrogen, 4 kg of phosphate and 16 kg of potash per tonne. Soils rich in exchangeable calcium and magnesium have also been reported to stimulate the growth of snails (Yoloye, 1988). On the contrary, Robert (2008) reported that nitrogen containing fertilizers like NPK fertilizer are repellant to snails and insects. In view of this, it becomes imperative for a thorough study

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to be carried out on the effect of various soils amendments on the performance of snails. This study therefore was designed to investigate the effect of treating soils with NPK fertilizer, poultry manure and magnesium sulphate on weight gain, shell length and shell aperture of snails.

MATERIALS AND METHODS

Experimental site: The study was carried out in the Zoological Garden of the Department of Zoology, Nnamdi Azikiwe University, Awka, Anambra state, Nigeria. Anambra State falls within the humid tropics of Nigeria and lies within longitudes 6°E and 8°E and between latitude 4°N and 10°N. It has a moderate climate with a very high temperature during the dry season and average rainfall during the rainy season. It has the mean annual temperature and precipitation of 35°C and 1118 mm, respectively.

Experimental animal: One hundred and eighty juvenile snails purchased from a reputable snail farm were used for the study. The snails were allowed to acclimatize with the environment for seven days before the onset of the experiment.

Procurement and preparation of manure: NPK fertilizer (15:15:15) and magnesium sulphate were procured from Anambra State Agricultural Development Project (ASADEP) at Awka, Anambra state, while the poultry manure was collected from the composted manure from a deep-litter poultry farm also at Awka. The Poultry manure was sun-dried for two weeks to reduce the ammonia content, thereafter, it was milled to powder.

Soil preparation and treatment groups: Loamy soil was collected from the vegetable farm behind the Zoology Garden. The soil was heated for one hour to reduce the pathogen load of the soil as recommended by Ebenebe *et al.* (2007). The soil was later allowed for 24 h to cool. Upon cooling, 60 kg of the soil was distributed into the plastic containers (housing pens for the snails) at the rate of 5 kg soil sample to 1.5 kg of soil treatment as proposed by Moyin-Jesu and Ajao (2008). There treatment groups were prepared as follow: treatment A consists of soil sample and NPK; treatment B consists of soil sample and magnesium sulphate; treatment C consists of soil sample and poultry manure, while treatment D contain soil sample only.

Housing and husbandry of experimental animals: Twelve plastic containers were filled with 5kg soil that has been treated with respective soil treatments: A1…A3 contained NPK fertilizer, B1…B3, contained magnesium sulphate, C1…C3 contained Poultry manure while three other additional containers labeled D1…D3 contained untreated loamy soil at the rate of 5 kg per container and therefore served as the control. One hundred and eighty snails were weighed and randomly assigned to the twelve plastic containers at the rate of 15 per container. The container measures 22.80 cm in diameter and 12.7 cm in height as recommended by Okonkwo *et al.* (2000). The containers were covered on top with wire netting to allow ventilation and prevent flies while the bottom of each container was drilled in a number of places to allow water drainage. During the 176 days period of the experiment the snails were offered equal quantities of feed (Paw-paw leaves and fruit, cabbage, palm nut, water leaves) and water. Leftover feeds were removed and the pens cleaned out every morning. The soil was changed on monthly basis with similarly treated soil to avoid build up micro-organisms. The environment in each container was humidified by sprinkling water into the buckets while water logging was avoided in all cases.

Experimental Design: The experiment was carried out under a Completely Randomized Design (CRD) with four treatments and three replicate groups. The experimental materials are homogenous, the only source of variability apart from experimental error is the treatment applied. The statistical model used:

$$Y_{ij} = \mu + t + e_{ij}$$

Where:

Y_{ij} = The observed performance of a snail
μ = The population mean
B_i = The effect of the treatment, $_i$ = 1, --, 4
e_{ij} = The error term associated with the observations

Assumptions; error term is independently, identically and normally distributed, with zero mean and constant variance, that is, iind (0, δ^2).

Data collection: Snails in each pen were weighed on weekly basis using electronic weighing balance in the laboratory to determine the weight gains. Weight measurements were taken to the nearest 0.01 g. The shell length was determined using veneer calipers while the shell aperture circumference was measured using twine which was later stretched on a meter rule. Both the shell length and shell aperture circumference were taken to the nearest 0.1 cm.

Statistical analysis: Data collected were subjected to Analysis of Variance (ANOVA) for Completely Randomized Design (CRD) to test the effects of the manorial treatment on the measured parameters. The differences between means were separated using Least Square Significant Difference (LSD) at 5% level according to Little and Hills (1978).

Table 1: Effects of different soil treatments on weight gain of *Archachatina marginata* snails

Soil treatment	Means of initial weight (g)	Means of final weight (g)	Means of weight gain (g)
NPK	32.73±1.10	44.17±1.25	11.44^{d}±0.63
$MgSO_4$	32.39±0.96	55.71±0.89	23.33^{b}±0.85
Poultry manure	32.96±0.76	59.05±1.07	26.09^{a}±0.88
Loamy soil	32.73±0.74	51.32±0.64	18.59^{c}±0.74

*Means bearing the different superscripts on along the mean column are significantly different (p<0.05)

Table 2: Effects of different soil treatments on shell length increase of *Archachatina marginata* snails

Soil treatment	Means of initial shell length (cm)	Means of final shell length (cm)	Means of weight shell length (cm)
NPK	4.03±0.42	4.87±0.31	0.10^{d}±0.38
$MgSO_4$	3.97±0.38	5.23±0.31	1.27^{b}±0.29
Poultry manure	4.07±0.31	5.47±0.31	1.40^{a}±0.32
Loamy soil	4.10±0.32	5.07±0.31	0.97^{c}±0.29

*Means bearing the different superscripts on along the mean column are significantly different (p<0.05)

Table 3: Effects of different soil treatments on shell aperture increase of *Archachatina marginata* snails

Soil treatment	Means of initial shell aperture (cm)	Means of final shell aperture (cm)	Means of weight shell aperture (cm)
NPK	5.70±0.44	6.47±0.39	0.77^{d}±0.38
$MgSO_4$	5.63±0.31	7.33±0.31	1.70^{b}±0.84
Poultry manure	5.67±0.33	7.93±0.31	2.27^{a}±0.31
Loamy soil	5.57±0.20	7.03±0.38	1.47^{c}±0.31

*Means bearing the different superscripts on along the mean column are significantly different (p<0.05)

RESULTS

Weight gain: The means of initial weight, final weight and weight gains within the 176 days of the study are presented in Table 1. The means of initial weights of the snails showed no significant difference but that of final weight and weight gain after the period of study showed significant difference with snails on pens with poultry manure having the highest mean final weight and weight gain of 59.05±1.07 g and 26.09±0.88 g, followed by those on pens that had Magnesium sulphate which had 55.71±0.89 g and 23.33±0.85 g for final weight and weight gain respectively. Snails on soil treated with NPK fertilizer had the least final weight and weight gain of 44.17±1.25 g and 11.44±0.63 g, respectively.

Shell length and shell aperture increase: Table 2 and 3 show the means of increase in shell length and shell aperture on snails raised under different soil treatments. The results followed similar trend with that of weight gain, with snails on soil treated with poultry manure having the highest increase in shell length and shell aperture (1.4±0.32 cm and 2.27±0.31 cm respectively), followed by those on soil treated with Magnesium sulphate (1.27±0.29 and 1.70±0.84 for increase in shell length and shell aperture respectively). Snails raised on soil treated with NPK fertilizer had the least increase in shell length and shell aperture of 0.1±0.38 cm and 0.77±0.36 cm, respectively.

DISCUSSION

The result of this study showed that *Archachatina marginata* performed better on soils treated with poultry manure (Treatment A) in all parameters measured, than in other treatments. The high nutrient composition of chicken manure may have contributed to the excellent performance of the snails raised in this treatment group. Kari (2000) reported that chicken manure contains 30 kg nitrogen, 41 kg phosphorus and 34 kg potassium per tonne. Sansoucy *et al*. (1995) observed that manure returns organic matter to the soil and help to maintain its structure as well as its water retention and drainage. Cobbinah (1993) also stated that soil that will support good performance of snail must be loose, rich in calcium and organic material.

Good performance in terms of better weight and shell length increase also recorded for snails on soil treated with magnesium sulphate is in line with the findings of Yoloye (1988). He reported that soils that are rich in exchangeable calcium and magnesium are ideal snail production in that it stimulates the growth of snails.

Snail in soil treated with NPK fertilizer had the least performance, even though the soil was rich in nutrients. This may be due to the fact that the individual nutrients like nitrogen are in more or less pure forms. Robert (2008) reported that NPK fertilizer act as a repellant to both snail and insects. According to him, the fertilizer act as a repellant by inhibiting feeding, disrupting growth, reproduction and metamorphosis in the case of insects. Many foliage feeding species of insects avoid plants treated with NPK fertilizer. The repellant action of NPK must have contributed to the findings in this study.

Conclusion: Soil amendment or treatment which is one of the common agronomic practices must be handled with caution in order to preserve numerous micro and macro animals inhabiting the soil. Specifically, NPK application must be restricted to field crops and other farm lands where it is extremely necessary. For profitable snail production, soil treatment with poultry manure and or magnesium phosphate is paramount.

REFERENCES

Adediran, J.A., N. De Baets, P.N.S. Mnkeni, L. Kienkens, N.Y.O. Muyima and A. Thys, 2003. Organic Waste materials for soil fertility improvement in the border region of the Eastern Cape. South Africa. Biol. Agric. Hortic., 20: 283-300.

Ajayi, S.S., 1980. Observation on the Nutritive Value of the African Giant Snail (*Archachatina marginata*). Afr. Wildlife J., 16: 85-95.

Ange, A.L., 1994. Integrated Plant Nutrition Management in Cropping and Farming systems: A challenge to Small Scale Farmers in Developing Countries, Food and Agricultural Organization, Rome Italy www.fao.org/wairdocs/ilri/x5462e/x5462e04.htm

Averahami, S., R. Conrad and G. Braker, 2003. Effects of temperature and fertilizer on activity and community structure of soil ammonia oxidizers and denitrifiers. Applied Environ. Microbiol., 68: 5685-5692.

Awah, A.A., 2000. Introduction to minlivestock development as a sustainable Agricultural Business. Workshop Paper presented at Agricultural Development Project (ADP) of Anambra, Imo, Rivers and Cross River States.

Cobbinah, J.B., 1993. Snail Farming in West Africa: A Practical Guide. Technical Centre for Agriculture and Rural Development (CTA), pp: 40.

Ebenebe, C.I., M.A. Anizoba, F.C. Agunwa and E.I. Tagbo, 2007. Differences in growth, reproductive performance and organoleptic properties between three species of snails (*Archachatina marginata*, *Achatina achatina* and *Achatina fulica*). J. Res. Biosci., (in press).

Imebvore, E.A., 1990. Management techniques in rearing ogf giant African Land Snail (*Archachatina marginata)*. J. Anim. Prod. Res., 8: 76-87.

Kari, 2000. Soil Fertility Management: Handbook For extension Staff and Farmers in Kenya. Technical note Series No 5. January 2000.

Little, T.M. and F.J. Hills, 1978. Agricultural Experimentation, design and Analysis. John Wiley and sons Publishers, USA, pp: 247-264.

Mead, A.R., 1961. The giant Africa snail, problem in Economic Malacology, University of Chicago Press, pp: 8.

Moyin-Jesu, E.I. and K. Ajao, 2008. Raising of giant African snail (*Archachatina marginata)* in urban cities using soil amendments and feedin materials for food security. Afr. J. Sci. Technol., Sci. Eng. Ser., 9: 119-124.

Okonkwo, A.C., L.J. Isaac, I. Nkanga and O.O. Usoro, 2000. Effect of Various Feeding Regimes on the Performance of Snails (*Archachatina marginata)*. Proceed. Of 25th Ann. Conf. of Nig. Soc. For Ani. Prod., pp: 314-315.

Robert, J.B., 2008. Environmental Horticulture. Institute of Food and Agriculture Sciences, University of Florida. Gainesville Florida. Organic Farming., 326: 11-12.

Sansoucy, R., M.A. Jabba, S. Ehui and H. Fitzhugh, 1995. The meaning and scope of Food Security. Roundtable ofn Livestock Development Strategies iFor Low Income Countries. FAO Rome, Italy.

Yoloye, L.V., 1988. Basic Invertebrate Zoology. Ilorin University Press. Ilorin, pp: 318.

Yoloye, V.L., 1994. Basics in Vertebrate Zoology, 3rd Edn., Ibadan, University Press, pp: 139-145.