International Journal of Innovation Scientific Research and Review
Vol. 02, Issue, 10, pp.468-471, October, 2020
Available online at http://www.journalijisr.com

IJISRR

Research Article

ISSN: 2582-6131

STUDIES ON DIFFERENT ASPECTS OF GROWTH AND FECUNDITY OF SNAIL LYMNAEA (RADIX) ACUMINATA (LAMARCK) OF SIMULTALLA LAKE (JHARKHAND)

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Received 18th August 2020; Accepted 26th September 2020; Published online 31st October 2020

ABSTRACT

Lymnaea acuminate is a fresh water snail and breeds throughout the year. The effect of pH, temperature and other physical factors influences the development, fecundity; hatchability and survival of young snails of L. acuminate were studied in this present piece of work. It was observed that these abiotic environmental various factors caused a significant variation in fecundity, hatchability and survival of snails. Maximum reproduction of this snail was observed in the monsoon season. A significant positive correlation (p , 0.05) between shell size and body weight (y= 2967x-0.647 and R2 =0.994) was observed. Maximum duration taken for the development were observed in the season of summer. Survival of young snails was observed for each month and each interval of 24–72 h. The egg production was observed maximum in the season of monsoon (265.0±1.50). Different hatchability were observed in different seasons. The total post reproductive survival and longevity was observed maximum in the season of monsoon. This study conclusively shows that variant abiotic factors in different months of the year can significantly alter the reproductive ability and development process in the snail Lymnaea acuminate.

Keywords: environmental factors, fecundity, hatchability, Lymnaea acuminate, monsoon.

INTRODUCTION

The Genus Lymnaea snails, important members of freshwater ecosystems, inhabits the freshwater bodies that are situated in the range of sea level up to the height of 10,000 feet; even in icy water, hot springs and in shallow waters to the depth of 250 meters (L.H. Hymen, 1967). The freshwater Pulmonate snail, Lymnaea acuminate (Lamarck) belongs to family Lymnaeidae that prefers either permanent or temporary water bodies with abundant vegetation. The Lymnaeidae is a very common family of the freshwater snails, the body visceral mass is characteristically wound in a right handed helicoids spiral and is enclosed in a shell which is secreted by its covering epithelium, the mantle or pallium. These animals are with dextral as well as sinisterly shell patterns with tapering tentacles, tubular pneumostome and separate gonophores' at the base of the right tentacle. Snails are hermaphrodite and breed almost throughout the year and lay down eggs on the submerged surface of aquatic plants (G.S. Pande;2008 & Kumar et al. 2016). The snail Lymnaea acuminata serves as intermediate host of some trematodes and other helminthes parasites which cause severe disease to domestic animals; they are serious agricultural and horticultural pest and also form an important link in aquatic food chains (Kumar et al. 2016). Snail Lymnaea In captivity lives for about 1. 5 to 3 years and sexually matures at an age of 2.5–3.5 months. Egg-laying slows down and may come to ceased in aged animals (Janse et al., 1989 & Shejwal et al., 2016).

LITERATURE REVIEW

This snail lives in water bodies such as lakes, streams, and wetlands with thick vegetation. It easily survives in polluted waters (Budha et al., 2014). Lymnaea snails is a known carrier of Fascioliasis, one of the most debilitating zoonotic diseases of domestic herbivores and human beings (Ashrafi et al. 2006; WHO 2006; Lewin 2007; Alatoom et al. 2008). Liver flukes Fasciola hepatica or Fasciola gigantica are the causative agent of fascioliasis (Ghanaei et al. 2006; Taheri et al. 2007). The freshwater snail Lymnaea acuminate is the intermediate host of F. gigantica (Singh & Agarwal 1981). Earlier studies have shown that the reproductive capacity of snails varies from one season to another (Maat et al. 1983; Wayne 2001). It has also been conclusively shown that oviposition in snails is induced by a neuroendocrine hormone of the Caudo-Dorsal Cells (CDCs) in the cerebral ganglion (Geraerts & Bohlken 1976; Takeda 1977; Maat & Lodder 1980; Maat et al. 1982; Singh et al. 2008). Several mechanisms are involved in the release of the ovipository hormone by environmental factors (Highnam & Hill 1977; De Jong-Brink et al. 1992). Environmental factors such as temperature, pH, dissolved oxygen, carbon dioxide and light/dark period are major seasonal variants that affect the morphological characteristics of CDCs (Maat et al. 1983; Wayne 2001). The objective of this study was to explore the possibility whether seasonal changes in the abiotic factors temperature, pH, dissolved oxygen and carbon dioxide, dark and light exposure can influence the fecundity, hatchability and survival of young snail L. acuminate in each month of the year 2010–2014. This will be helpful in deciding the most suitable time in the year for their control.

MATERIALS

The live specimens of Lymnaea acuminate snails were collected from the Simultalla jhel located at Simultalla, Jharkhand. Six standard size aquarium having a capacity of 8- 10 liters of water for acclimatization and egg laying. Five liters of de-chlorinated tap water and pond water for control and test tanks respectively.

METHODOLOGY

Adult *L. acuminate* (2.50 ± 0.30 cm in length) were collected from the banks of Simultalla Jheel, Jharkhad and brought to University Lab

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of University Department of Zoology, Tilka Manjhi Bhagalpur University, Bhagalpur for further experimentations.. The collected snails were acclimatized in de-chlorinated tap water for 72 h. The following experiments were carried out in different regimens of water. Five liters of De-chlorinated tap water was used for control and five liters of pond water, changed at 24 h for individual test group. Five test groups of twenty snails were kept in five glass aquaria separately with 5 liters of pond water. Both Control and test groups aquaria contain 20 snails of uniform shape and water of each aquaria were changed after 2 days alternation. The aquaria were covered with wire netting to prevent the animals from escaping. *L. acuminate* laid their eggs in the form of elongated gelatinous capsules containing eggs on the surface. After every 24 h, 48 h up to 96 h, the total number of eggs ovipositor by the snails were counted in each aquarium and their further developmental were monitored and recorded for growth performances. pH, temperature, organic carbon content, amount of NPK and other elements were recorded at the site of sample collection through standard methods.

RESULTS

Results of the present piece of work are shown in the form of tables and graphs. Table 1.0 shows the growth performance over 14 weeks. A linear growth pattern of Shell length (mm) and Body weight (mg) was observed in test groups as an average of five experimental groups with S.D. were calculated and depicted in table 1.0.

Table 1.0 Growth performance in relation to weeks incubated

Weeks	Shell Length (mm) Mean ± S.E	Body Weight (mg) Mean ± S.E
0	0.78 ± 0.33	0.24±0.01
1	3.80±0.08	4.43±0.31
2	7.85±0.27	50.30±3.94
3	9.40±0.25	109.25±8.31
4	11.60±0.24	193.50±10.82
5	13.18±0.15	282.29±7.69
6	14.60±0.19	345.29±8.06
7	15.75±0.21	387.00±21.03
8	16.87±0.19	548.38±29.42
9	18.25±0.12	627.50±39.33
10	19.42±1.18	801.00±61.05
11	20.25±1.15	862.00±91.70
12	21.00±0.84	955.80±101.33
13	21.88±0.94	1076.25±149.11
14	23.25±1.59	1173.50±163.69

Fig. 1.0 and 2.0 shows the Line Fit Plot for Shell Diameter and Regression correlation coefficient between bogy weight (mg) and Shell diameter (mm). Both figures show a linear correlation of body weight with growth over weeks. Line Fit plot with R2 =1 suggests the growth is uniform and idealistic. The regression Correlation line with y= 2967x-0.647 and R2 =0.994 suggest almost linearity between Body weight and Shell diameter over growth period with marginal decrease of linearity at around last developmental condition.

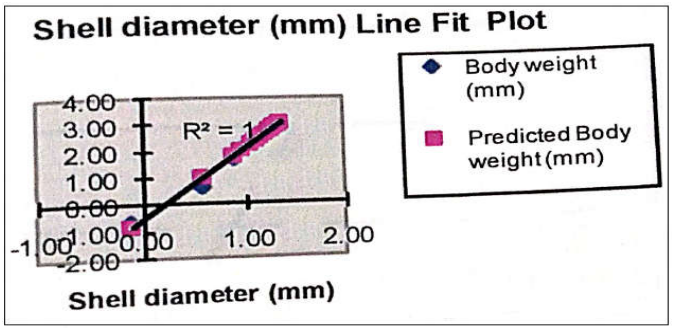

Fig. 1. Line Fit Plot of Body Weight (mm)

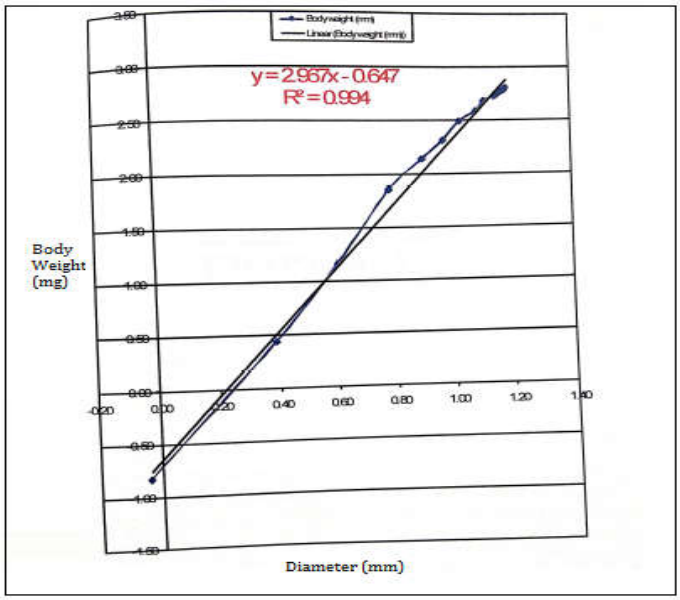

Fig. 2. Regression correlation coefficient between body weights (mg) with diameters (mm)

Different physical parameters oat the site of sample collection along with the amount of metal ions are shown in table 2.0. The mean values of pH was found in acidic zone while temperature at 350C. The amount of organic carbon, available K2O, Cu, Fe and Mn was recorded in higher amount than reference values, while, available N and P2O5 were recorded in lower amounts than the reference .

Table 2. Physical parameters and Metal concentration in sediment sample of Simultalla jheel

Sr. No.	Parameters	Mean Values	Status
1	pH	6.30	Acidic
2.	Temperature (Degree celcius)	35	Normal
3	EC (ds/m)	0.114	Normal
4	Organic Carbon	0.82	High
5	Available N (Kg/ha)	188.16	Low
6	Available P_2O_5 (Kg/ha)	116.96	Low
7	AvailableK_2O (Kg/ha)	587.25	High
8	DTPA-Zn (ppm)	1.12	Normal
9	DTPA-Cu (ppm)	6.07	High
10	DTPA-Fe (ppm)	21.66	High
11	DTPA-Mn (ppm)	13.00	High

Table 3.0 shows the fecundity of egg produced by snails after four time intervals (24, 48, 72 and 96 hrs). The overall highest fecundity was reported in snails observed during monsoon season in all time interval patterns except 96 hrs. In 24 hrs time interval, monsoon grown snails shows highest fecundity (265.0±1.50) while winter grown snails shoes lowest fecundity (180.0±1.25). Highest (200.0±1.25) and lowest (158.0±1.0) fecundity were observed in monsoon and winter season snails within 42 hrs experimental group. Similarly, within 72 hrs experimental set, highest (215.0±1.35) and lowest (180.0±1.25) fecundity were shown by monsoon and winter grown snails. Within 96 hrs after fecundity observation, it was revealed that the highest (198.0±1.0) and lowest fecundity (175.0±0.15) is associated with spring and winter seasons. Effect of seasonal variations on the reproductive potential is shown in table 4.0. The data suggest, during monsoon snail attains faster sexual maturity (46 Days) and produces more capsules (165), total no eggs (2391), have higher Post-Reproductive periods (4 days) as well as longevity (145 days). Winter season is found not much suitable for said parameters. During winter sexual maturity is delayed (50 Days) and produces lesser capsules (89), total no eggs (1443), have less Post-Reproductive periods (2days) as well as longevity (100 days).

Table 3. Fecundity of Eggs of Lymnaea acuminate

Seasons	Fecundity after 24 hrs (No. of Eggs of 20 Snails)	Fecundity after 48 hrs (No. of Eggs of 20 Snails)	Fecundity after 72 hrs (No. of Eggs of 20 Snails)	Fecundity after 96 hrs (No. of Eggs of 20 Snails)
Summer	245.66±1.17	193.66±1.76	185.0±1.76	188.0±0.55
Monsoon	265.0±1.50	200.0±1.25	215.0±1.35	195.0±0.65
Winter	180.0±1.25	158.0±1.0	180.0±1.25	175.0±0.15
Spring	210.0±1.30	165.0±1.25	190.0±1.80	198.0±1.0

Table 4. Seasonal variation in Reproductive performance of Lymnaea acuminate

Snail Index Culture	Age attainment of sexual maturity	Total no. of capsules produced	No. of eggs per capsule		Total No. of eggs produced	Reproductive period (Days)	Post Reproductive periods (Days)	Longevity (Days)
Summer Season	46	94	Range Mean	7-30 18.33	1723	53	1	99
Monsoon Season	47	165	Range Mean	2-27 14.49	2391	95	4	145
Winter Season	50	89	Range Mean	3-29 16.21	1443	49	2	100
Spring Season	49	92	Range Mean	5-28 17.23	1625	52	2	99
$\overline{X}$	48.00	110.000			1795.5	62.25	2.25	110.75

Table 5. Seasonal variation in duration of developmental period of Lymnaea acuminate

Stage	Summer	Monsoon	Winter	Spring
Egg (incubation period)	6-8	8-9	8-10	7-9
Morula (Total duration)	1	2	3	1
Trochophore	2-3	3-4	4-5	1-2
Veliger	3	4	5	2
Hippo	2-3	3-4	4-5	2-3
Total duration of development of sexually matured adult (Days)	37	47	51	39

The different developmental stages along with their associated duration of that particular stage are depicted through table no 5.0. Whole developmental stages (05) were observed in different seasons for the observation of their associated developmental periods in days. As it is evident from the table that summer season conditions induces faster development of different stages with respect to other seasons. Total duration taken for different developmental stages was found to be minimum (37 days) during summer and maximum (51days) within winter season.

DISCUSSION

It is evident from the results that temperature, pH, dissolved oxygen and carbon dioxide alter the fecundity, hatchability and survival of snails. In the summer season (June–August) the temperature of the water is high (35–370C). The fecundity of the snails was usually high when the temperature of water increased up to 350C, i.e. in the month of May-June. In contrast, when the temperature of the water increased above 350C and decreased below 150C i.e. in the months of July and January respectively, there was a marked decrease in fecundity. An earlier study has shown that the decrease in temperature from 200C to 80C stopped the oviposition of the snail Lymnaea stagnalis because of a reduction in the activities of neurosecretory cells (CDCs) (Dogterom et al. 1984; Wayne 2001). It seems that for normal fecundity, hatchability and survival of young snails L. acuminate the average temperature of water should be around 350C, as evident in the control group of snails. Presence of different metal ions and suspended organic carbon are one of the most important ecological parameters directing the growth and reproductive potential of L. acuminate (Ingram et al. 1997).

CONCLUSION/SUMMARY

From the present piece of work it was concluded that the environmental condition of summer season increases the faster growth of different developmental stages and fecundity within the snail Lymnaea acumina and reverses in the winter seasons. This may be correlated with the physiology of poikilotherms, that cannot regulate their own body temperature to optimize the physiology. During summer the environmental condition provides optimal condition to promote growth, similarly, the prevailing environmental condition during monsoon maximizes the fecundity.

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