

Adaptive Radiation and the Macro-Systemic Aspects of Diversity and Eco-systemic Characteristics



Sangeeta Giri

M.Phil, Roll No: 142135

Session: 2014-15

University Department of Zoology

B.R.A Bihar University, Muzzaffarpur

DECLARATION: I AS AN AUTHOR OF THIS PAPER / ARTICLE, HEREBY DECLARE THAT THE PAPER SUBMITTED BY ME FOR PUBLICATION IN THE JOURNAL IS COMPLETELY MY OWN GENUINE PAPER. IF ANY ISSUE REGARDING COPYRIGHT/PATENT/ OTHER REAL AUTHOR ARISES, THE PUBLISHER WILL NOT BE LEGALLY RESPONSIBLE. IF ANY OF SUCH MATTERS OCCUR PUBLISHER MAY REMOVE MY CONTENT FROM THE JOURNAL WEBSITE. FOR THE REASON OF CONTENT AMENDMENT/ OR ANY TECHNICAL ISSUE WITH NO VISIBILITY ON WEBSITE/UPDATES, I HAVE RESUBMITTED THIS PAPER FOR THE PUBLICATION. FOR ANY PUBLICATION MATTERS OR ANY INFORMATION INTENTIONALLY HIDDEN BY ME OR OTHERWISE, I SHALL BE LEGALLY RESPONSIBLE. (COMPLETE DECLARATION OF THE AUTHOR AT THE LAST PAGE OF THIS PAPER/ARTICLE

Abstract

An integral part of ecosystems from terrestrial to deep marine environments, annelids are a phylum of segmented bilaterian organisms. The morphological and taxonomic variety of annelids is outstanding, and they have developed a wide range of feeding mechanisms and ecologies. Their interactions and development have been the subject of intense debate over the last century, with significant recent changes made to the body plan of the ancestral annelid, the connection between main groups, and the makeup of the annelid crown group. A strong amount of molecular data suggests that clitellates are descended from polychaetes and that they constitute a paraphyletic grade. Errant, Epibenthic polychaetes are the oldest stem group annelids found in Cambrian Lagerstedt, demonstrating the primordial nature of annelid features like as biramous parapodia, head appendages, and diversified, simple chaetae. Crown group annelids are thought to be a radiation from the Late Cambrian to the Early Ordovician, with clitellates propagating in the Late Palaeozoic, according to recent data from molecular clocks and the fossil record. The majority of their body fossil record is restricted to deposits with extraordinary preservation, and it is broken up by the acquisition of hard pieces in significant groups. Machaeridians are in reality a clade of crown polychaetes, as shown by the finding of an Ordovician fossil containing soft tissues. They have been around for more than 200 million years and have distinctive calcitic dorsal armour, which makes it possible to analyse their way of life and phylogeny in the context of the annelid body plan. We find the Cuniculepadida, a distinct clade of machaeridians, which has many adaptations for burrowing.

Keywords: machaeridians, epibenthic polychaetes, Macro System, Annelids

1. Introduction

A taxon of protostomes known as annelids includes more than 17,000 species that are scattered around the planet and may be found in terrestrial, aquatic, and marine settings. For a long time, their phylogeny was up for debate, but more recent phylogenomic analysis produced a clear backbone for this group. The derived annelid taxa Clitellata, Echiura, and Pogonophora

(Siboglinidae) are also included in the Sedentaria. In the base of the annelid tree, there are a number of groups besides Sedentaria and Errantia, including Sipuncula, Amphinomida, Chaetopteridae, Magelonidae, and Oweniidae. Together, the latter two taxa make up the sister taxon to all other annelids. Given this theory, it must be considered that the Lower Cambrian, at the very least, was the time of the early diversification of current annelids. Myzostomida, a class of parasites and commensals of echinoderms (and sometimes cnidarians), is still not well positioned in the phylogeny. Although there is considerable evidence for an annelid ancestry, its precise location is still unknown. Several interstitial taxa's phylogenetic position is also still up for question. It is still unclear where Annelida fit within Protostomia. Recent phylogenomic investigations do, however, uncover a clade that unites annelids with the Mollusca, Nemertea, Brachiopoda, and Phoronida, although there is little evidence to support any sister group relationships. Since the body plans of annelids vary greatly, it is challenging to identify a single consistent anatomy that would account for most of this variability. The majority of annelids are coelomate animals, meaning they have numerous segments that run repeatedly along the body's anterior-posterior axis. If segmentation is present, the annelid body is split into a prostomium, a segmented trunk that is either homonomously (meaning that all of the segments are the same) or heteronomously (meaning that some of the segments are different from one another). The brain is often located in the prostomium of many annelid taxa, however in Clitellata, the brain may be found in the following parts. The annelids' heads may include appendages like palps or antennae, although other genera lack them. The first part, known as the peristomium, contains the mouth. A process mimicking moulting may be used to replace sclerotized mandibular features that are present in a number of Errantia and Amphinomida species. In addition to a pair of nephridia (often metanephridia), coelomic chambers, ganglia, and ventral and dorsal groups of chitinous chaetae that may be arranged in parapodia, many annelids include segments. A posterior growth zone that is in advance of the pygidium produces segments. The anus, which is typically dorsally or terminally situated and often has pairs of cirri, is contained inside the pygidium.

1.1.Objective of the Study

- To Know the molecular mechanism of UV-B induced damage of photosynthetic apparatus (PSA)

- To determine the difference in the effects of UV-A from those of UV-B on the structure and function of PSA.
- To compare the responses of chloroplasts to UV-B and UV-A and
- To examine the role of UV-A radiation in the adaptation and protective mechanisms of the cluster bean cotyledons.

2. Distribution and Abundance

Worldwide, annelids may be found in many kinds of environments, although they are most prevalent in freshwater, marine waters, and moist soils. The majority of polychaetes are sea creatures that float, burrow, walk on the bottom, or live in tubes they build. They may vary in colour from spectacular to drab, and some species are even able to create light. The United States' Great Lakes and a few rivers are home to the feather duster (*Manayunkiaspeciosa*). More than 6,000 different species of polychaetes have been identified, with free-moving and tube-dwelling types making up about equal numbers. There are roughly 3,250 recognised species of oligochaetes. Several tiny oligochaetes are found in fresh water, while a few are marine, mainly living in estuaries or other shallow seas. Oligochaetes, such as earthworms, burrow through soil. About 300 different species of leeches live in watery or humid habitats and are either carnivorous or parasitic on other living things. For example, all marine leeches parasitize fish.

2.1. Size range and diversity of structure

An annelid's length may range from less than one inch to more than six metres (about 20 feet). In the contracted condition, the breadth may be more than 2.5 cm (about one inch). The biggest species are earthworms and freely moving polychaetes. When constricted, leeches may reach lengths of roughly 0.4 metres.

2.2. Importance

Large earthworms, often known as night crawlers (*Lumbricusterrestris*), are raised and marketed for use as humus builders in gardens and as bait for freshwater fish. The sludge worm *Tubifex* is

harvested and marketed as tropical fish food since it is common near sewage outlets and serves as a sign of water contamination. Polychaetes are crucial in rearranging the silt on the ocean floor. Leech therapy, which has a long history and was at its height in the first half of the 19th century. Both indigenous species and the European species *Hirudomedicinalis* have historically been utilised. Hirudin, a leech extract, is used as a blood thinner. The primary sources of bloodworm (*Glyceradibranchiata*), which is used as bait for saltwater fish, are the estuary flats of Maine and Nova Scotia. In Samoa in the south Pacific, reproductive portions of the palolo (*Palolasiciliensis*), which separate and are present in large quantities during the reproductive phase, are utilised as food.

2.3. Life Cycle

It may seem like polychaetes and oligochaetes are ageless due to their ability to regenerate, or grow back missing pieces (see below). However, there aren't many research on polychaetes' lifespan. Most of the investigated species' adults have a typical number of segments, which develop quickly during early life and before gametes are visible. Many polychaetes, particularly those of the nereids, only reproduce once before passing away. These worms are consumed by fish and other animals in nature, where they are often relatively slow after spawning. There are polychaete species that may survive anywhere from one month (*Dinophilus*) to three years (*Perinereis*). Species that form stolons (stems), such as the syllids, or whose posterior end breaks off, such as the palolo, are capable of repeating the process; but the number of times and the length of time they are able to do so have not been established. The majority of stationary polychaetes live after spawning, however it is yet unknown how often this cycle might occur.

3. Literature Review

According to Clark (1964), the segmentation of the ancient annelid, an infauna creature, developed in order to compartmentalise the coelom and facilitate peristaltic digging. In contrast, Westheide (1997) asserted that internal segmentation was prompted by the formation of parapodia in order to meet the need for blood supply. It is abundantly obvious from the current evolutionary theory of annelids, in which polychaetes are descended from clitellates, that chaetae, parapodia, and palps constitute a primordial feature of annelid body plans (Struck et al. 2011; Eibye-Jacobsen and

Vinther 2012). Although parataxonomy hindered early scolecodont studies, more apparatus-based research has been done recently to examine the development of jaws in deep time by combining current and ancient data (Whittle et al. 2008; Paxton 2009; Paxton and Eriksson 2012). The Middle Devonian of Canada has the first unmistakable phyllodocidan body fossils (Farrell and Briggs 2007).

4. Materials and Methods

4.1. Growth Condition and UV Exposures

Clusterbean (*Cyamopsis tetragonoloba* L. cv. PusaNavbahar) seedlings were grown in laboratory condition as described in section II.2.1. The seedlings in different Petri plates were exposed to either UV-A (Philips TL 20, Type 09, 320-400 nm with peak at 365 nm, 75 pmol/m²/s), UV-B (Philips TL-20, Type 05, 280-315 nm with peak at 315 nm, 60 pmol/m²/s) and UV-A + UV-B (UV-A and UV-B radiation simultaneously) as described by Joshi et al. (2007). As demonstrated in last chapter the cotyledons follow the developmental pattern of juvenile phase up to d 6 and steady phase from d 7 to 10 followed by declining senescence phase, the experimental period was limited to d 10 and the exposures of seedlings to these radiations separately or in combination were carried out for 1 h daily from d 1 till 10. Different biochemical and biophysical measurements were conducted on d 10 to examine the responses of PSA to UV exposure.

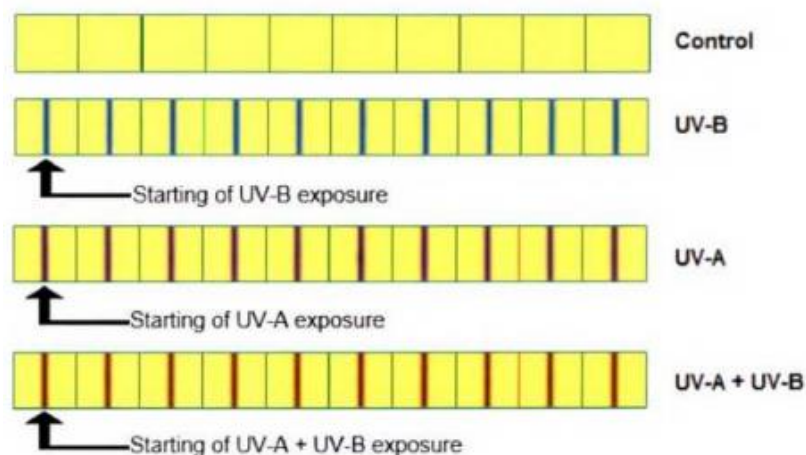


Figure 1: Clusterbean

Above is a schematic illustration of various UV exposures from days 1 to 10. The seedlings were exposed to UVB, UVA, and UVA + UVB radiation for one hour each day as shown by the blue, violet, and purple lines inside the boxes. These bars' boxes each represent a day. Seedlings grown in white light are shown as control samples in the top bar (yellow boxes).

5. Result and Discussion

5.1. UV-induced Alteration in Photosynthetic Pigment Content

The pattern of changes in total Chi in the cotyledons of clusterbean seedlings exhibited an increasing trend till day 7 and then the pigment content remained almost constant till d 10 [Fig. (2) 1], UV-B irradiation decreased the content of total Chi and the decrease was furthered with the progress of UV-B dose. On day 10, the content of Chi declined by 10.4% ($p>0.005$), 6.35% ($p>0.005$) and 4.12% ($p>0.005$) in response to UV-B, UV-A and UV-A + UV-B exposures, respectively. Under UV-A + UV-B irradiation the content of total Chi was less than that in the control, but the decline was less than that caused by UV-B alone. The kinetics of total Chi content in UV-A + UV-B irradiated cotyledons was almost parallel but at a lower level compared to that of control cotyledons. The effect of UV-A radiation alone on the pigment content during the period under study was insignificant.

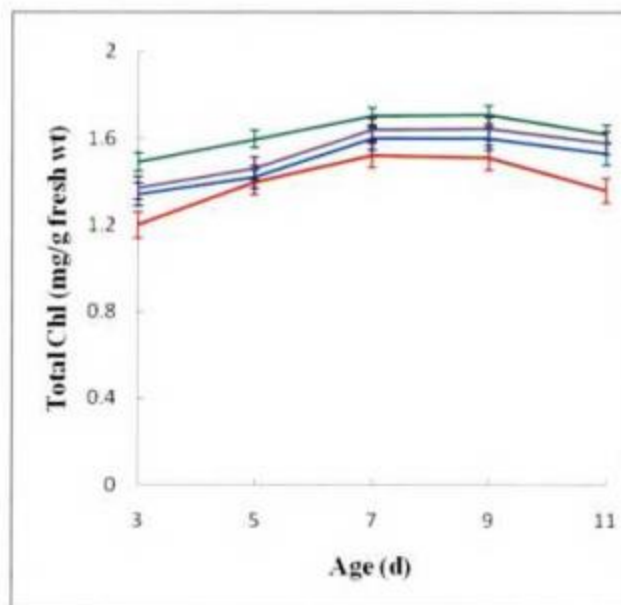


Fig. (2): Time course of changes in the contents of total Chi in the cotyledons of clusterbean seedlings under continuous light (Green),

Fig. [2] describes the time course of changes in Car content with UV-B, UV-A and UV-A + UV-B irradiation and the trend in loss are similar to that of Chi. On d 10, the loss of Car in UV-B, UV-A and UV-A + UV-B irradiated cotyledons of clusterbean seedlings was 30.5(p>0.01), 16.5(p>0.01) and 7.2 (p>0.01)% , respectively

6. Conclusion

The UV-B radiation inactivates the PSA by inflicting damage at multiple site(s). PSII is the primary target of the radiation. UV-B radiation induces an imbalance in the source of energy and sink capacity and a loss in redox homeostasis between Qa and Qb of PSII. These changes in photostasis of photosynthesis and redox homeostasis ultimately results in ROS metabolism and plant damage. The excessive ROS metabolism has been considered as the cause of thylakoid lipid peroxidation and loss in membrane integrity. UV-A radiation also damages the PSA but the degree of damage is very small. The level of alteration in photosynthetic pigments, Chl/Car and Chi a/b ratios in UV-A + UV-B exposed seedlings, is observed to be less than the ones in UV-B exposed

seedlings. Relatively lesser accumulation in MDA together with the higher level of photosynthetic pigments suggests that the state of thylakoid membrane in UV-A + UV-B exposed seedlings is better than the one in UV-B exposed seedlings.

References

1. BRACCHI, G. and ALLESSANDRINI, A. 2005. Paleodiversity of the free-living polychaetes (Annelida, Polychaeta) and description of new taxa from the Upper Cretaceous Lagerstätten of Haql, Hadjula and Al-Namoura (Lebanon).
2. BRIGGS, D. E. and BARTLETT, C. 2010. Annelids from the Lower Devonian Hunsrück Slate (lower Emsian, Rhenish Massif, Germany).
3. CLARKSON, E. N. 1987. The first tomopterid, a polychaete from the Carboniferous of Scotland. *Lethaia*.
4. KEAR, A. J. 1993. Decay and preservation of polychaetes; taphonomic thresholds in soft-bodied organisms.
5. BRINKHURST, R. O. 1992. Evolutionary relationships within the Clitellata. *Soil Biology and Biochemistry*.
6. CONWAY MORRIS, S. 1979. Middle Cambrian polychaetes from the Burgess shale of British Columbia. *Philosophical Transactions of the Royal Society of London*.
7. FAUCHALD, K. and JUMARS, P. A. 1979. The diet of worms: a study of polychaete feeding guilds.
8. HUANG, D. Y., CHEN, J. Y., VANNIER, J. and SALINAS, J. I. S. 2004. Early Cambrian sipunculan worms from southwest China.
9. SHEN, X., MA, X., REN, J. and ZHAO, F. 2009. A close phylogenetic relationship between Sipuncula and Annelida evidenced from the complete mitochondrial genome sequence of *Phascolosoma esculenta*.
10. Orrhage L, Müller MCM (2005) Morphology of the nervous system of Polychaeta (Annelida).
11. Okada K (1957) Annelida. In: Kumé M, Dan K (eds) *Invertebrate embryology*.
12. Purschke G (2002) On the ground pattern of Annelida.

13. Purschke G (1997) Ultrastructure of nuchal organs in polychaetes (Annelida)—new results and review.
14. Pilger JF (2002) Phylum Echiura. In: Young CM (ed) Atlas of marine invertebrate larvae.
15. Meyer N, Boyle M, Martindale M, Seaver E (2010) A comprehensive fate map by intracellular injection of identified blastomeres in the marine polychaete *Capitella*.
16. Lillie FR (1909) Polarity and bilaterality of the annelid egg. Experiments with centrifugal force.
17. Ferrier DEK (2012) Evolutionary crossroads in developmental biology: annelids.
18. Adamse P, Britz SJ (1992) Amelioration of UV-B damage under high irradiance. I; role of photosynthesis. *Photochem Photobiol* 56: 645-650
19. Albert KR, Mikkelsen TN, Ro-Poulsen H, Michelsen A, Arndal MF, Bredahl L, Hakansson KB, Boesgaard K, Schmidt NM (2010) Improved UV-B screening capacity does not prevent negative effects of ambient UV irradiance on PSII performance in High Arctic plants. Results from a six year UV exclusion study. *J Plant Physiol* 167; 1542-1549
20. Albert KR, Ro-Poulsen H, Mikkelsen TN, Bredahl L, Hakansson KB (2005) Effects of reducing the ambient UV-B radiation in the high arctic on *Salix arctica* and *Vaccinium uliginosum*. *Phyton* 45; 41-49.

Author's Declaration

I as an author of the above research paper/article, hereby, declare that the content of this paper is prepared by me and if any person having copyright issue or patent or anything otherwise related to the content, I shall always be legally responsible for any issue. For the reason of invisibility of my research paper on the website/amendments /updates, I have resubmitted my paper for publication on the same date. If any data or information given by me is not correct I shall always be legally responsible. With my whole responsibility legally and formally I have intimated the publisher (Publisher) that my paper has been checked by my guide (if any) or expert to make it sure that paper is technically right and there is no unaccepted plagiarism and the entire content is genuinely mine. If any issue arise related to Plagiarism / Guide Name / Educational Qualification / Designation/Address of my university/college/institution/ Structure or Formatting/ Resubmission / Submission /Copyright / Patent/ Submission for any higher degree or Job/ Primary Data/ Secondary Data Issues, I will be solely/entirely responsible for any legal issues. I have been informed that the most of the data from the website is invisible or shuffled or vanished from the data base due to some technical fault or hacking and therefore the process of resubmission is there for the scholars/students who finds trouble in getting their paper on the website. At the time of resubmission of my paper I take all the legal and formal responsibilities, If I hide or do not submit the copy of my original documents (Aadhar/Driving License/Any Identity Proof and Address Proof and Photo) in

spite of demand from the publisher then my paper may be rejected or removed from the website anytime and may not be consider for verification. I accept the fact that as the content of this paper and the resubmission legal responsibilities and reasons are only mine then the Publisher (Airo International Journal/Airo National Research Journal) is never responsible. I also declare that if publisher finds any complication or error or anything hidden or implemented otherwise, my paper may be removed from the website or the watermark of remark/actuality may be mentioned on my paper. Even if anything is found illegal publisher may also take legal action against me

Sangeeta Giri
