

First successful documentation on the embryonic, larval and juvenile development of the tropical sea urchin, *Diadema setosum* (Leske, 1778)

ABSTRACT

The tropical sea urchin, *Diadema setosum* belonging to the Family Diadematidae, is one of the regular echinoids, widely distributed throughout the warm Indo-West Pacific Ocean including the Malaysian intertidal reef. It has profound biological, ecological, aquacultural and pharmaceutical significance, but yet to be fully determined and explored. In order to examine the developmental basis of morphological changes in embryos, larvae, we have thoroughly studied the ontogeny of *D. setosum* in a controlled laboratory condition. Gametes were obtained from the sexually matured adult individuals and the eggs fertilized using limited concentration of *ödryö* sperm (10-5 dilution). Fertilization rate was estimated to be $96.8 \pm 1.3\%$ and the resulting embryos were reared at 24-25°C. The first cleavage (2-cell), 4-cell, 8-cell, 16-cell, 32-cell and multi-cell (Morulla) stages were achieved at 01.20, 02.14, 02.44, 03.09, 03.32 and 03.54 h post-fertilization, respectively. Ciliated blastulae with a mean length of 111.47 ± 1.88 μ m hatched 08.45 h following sperm entry. The Gastrulae attained at 16.36 h post-fertilization and the archenteron extended constantly, while the ectodermal red-pigmented cells migrated synchronously to the apical plate. The 4-arm pluteus larva formed with two well-developed postoral arms 48.30 h following fertilization. In this stage, pluteus larva experienced with complete digestive tract and was able to feed on unicellular algae (*Chaetoceros calcitrans*) in 2 d, grew continuously, and finally attained metamorphic competence at 35 d after fertilization. Settlement induction and metamorphosis took approximately 1 h 30 min from the attachment on the substratum followed by the complete resorption of larval tissues and the development of complete juvenile structure with adult spines, extended tubefeet and well-developed pedicellaria, the whole event usually took place within 1 d post-attachment. The newly formed juvenile (473.16 ± 6.96 μ m) with a complete adult structure (mouth, gut, anus, spine, tubefeet etc) then grew on coralline algae to 1-, 2- and 3-month old juvenile by increasing the overall juvenile body, spine and tube foot lengths. The 3-month old juvenile represents the *ösea* urchin seed *ö* for stocking in grow-out culture. This study is the first successful investigation on embryonic, larval and juvenile development of *D. setosum*, the findings of which would immensely be helpful towards the development of induced breeding, seed production and aquaculture of sea urchins in captive rearing condition.

Keyword: Sea urchin; *Diadema setosum*; Embryo; Larva; Juvenile; Development; Growth