Chapter-3

Influence of temperature on predation of the V instar of D.indicus
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3.1 Introduction

Temperature has been considered as a major factor that controls metabolism and development. According to Anderson and Sedell (1979), temperature influences trophic dynamics directly through its effect on phenomenon such as feeding rates, and indirectly through the food base available to aquatic insects. Feeding rates, assimilation efficiency and egestion are often a function of temperature (Gose, 1970 and Heiman and Knight 1975). Thompson (1978a) reported that temperature influenced prey consumption in the damselfly *Ischnura elegans*. The predator consumed more prey at higher temperatures. According to Pandian et al (1979) the number of mosquito larvae predated by the dragonfly nymph increased in relation to increase in temperature.

Saha and Raut (1988) found that temperature influenced the predation of the water bug *Sphaerodema annulatum* on the vector snail *Lymnea luteola* Macleord and Pessah (1973) were of the opinion that temperature increases feeding efficiency due to the increased active metabolism. Increase in water temperature increased oxygen consumption in *D. indicus* (Venkatesan et al, 1993). Spence et al (1980) studied the effects of temperature on growth and development of water striders and found that larval production and development are strongly temperature dependent. Whittow (1970) reported that the physiological adjustments occur when an animal is exposed to environmental condition differing from those in which it has been living.

The present study on the influence of temperature on the food intake in *D.indicus* has relevance to the conditions of mass rearing. The V instar larvae of
D. indicus is voracious feeder of mosquito larvae compared to other instars, hence it was selected to observe the influence of temperature on the predator efficiency. The entire period of V stadium was studied.

3.2 Materials and Methods

The encumbered males of D. indicus were collected from the Puthan pond and maintained in the laboratory in glass aquaria with aged tap water. They were fed with the third size class larvae of Culex sp. The eggs were allowed to hatch and the instars were maintained in experimental glass aquaria of 1 litre capacity. The V instar larvae were selected for the study on the influence of temperature on predatory efficiency. The number of Culex larvae predated by the V instars larvae of D. indicus in 7 test temperatures for the entire V stadium was studied.

The desired temperatures 25, 27, 29, 31, 33, 35, and 37°C were maintained in BOD incubators. The larvae were acclimated to the particular test temperature before experimentation. Ten replicates were maintained for each test temperature.

The predators were exposed to a density of 50 third class larvae of Culex sp and the number of dead prey items were replaced every 12 hours and the density was always maintained at 50. The number of Culex larvae predated by the predator during the entire V stadium in the 7 test temperatures were noted and tabulated.

3.3 Results

The predatory efficiency of the V instar of D. indicus on Culex larvae during the entire V stadium in the 7 test temperatures were summarized and tabulated. (Table-1 and Figure-1).
Table-1

Influence of temperature on *Culex larvae* predated by the V instar of *D.indicus*

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Number of <em>Culex</em> larvae predated</th>
<th>V stadium(days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>238.4 ± 6.1</td>
<td>11.2 ± 0.3</td>
</tr>
<tr>
<td>27</td>
<td>260.2 ± 5.2</td>
<td>9.25 ± 0.4</td>
</tr>
<tr>
<td>29</td>
<td>258.3 ± 5.9</td>
<td>9.2 ± 0.25</td>
</tr>
<tr>
<td>31</td>
<td>264.8 ± 6.25</td>
<td>9.25 ± 0.1</td>
</tr>
<tr>
<td>33</td>
<td>278.9 ± 5.31</td>
<td>8.5 ± 0.25</td>
</tr>
<tr>
<td>35</td>
<td>285.5 ± 3.8</td>
<td>8.41 ± 0.32</td>
</tr>
<tr>
<td>37</td>
<td>281.3 ± 4.12</td>
<td>8.16 ± 0.4</td>
</tr>
</tbody>
</table>

Figure-1 Graph showing the influence of temperature on *Culex larvae* predated by the V instar of *D.indicus*
25°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 25°C was 238.4±6.1. The V stadium lasted for 11.2 ± 0.3 days.

27°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 27°C was 260.2 ± 6.1. The V stadium lasted for 9.25 ± 0.4 days.

29°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 29°C was 258.3 ± 5.9. The V stadium lasted for 9.2 ± 0.25 days.

31°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 31°C was 264.8 ± 6.25. The V stadium lasted for 9.25 ± 0.1 days.

33°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 33°C was 278 ± 5.31. The V stadium lasted for 8.5 ± 0.25 days.
35°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 35°C was 285.5 ± 3.8. The V stadium lasted for 8.41 ± 0.32 days.

37°C Temperature

The number of *Culex* larvae predated by the V instar larvae of *D. indicus* during the entire V stadium at 37°C was 281.3 ± 4.12. The V stadium lasted for 8.16 ± 0.4 days.

3.4 Discussion

Temperature has been a major factor that regulates seasonal changes in the growth rate of insect population. Temperature influences largely the feeding rates (Anderson and Sedell, 1979). Feeding rate, assimilation efficiency and egestion are often influenced by temperature (Gose 1970; Heiman and Knight, 1975)

Field investigations revealed that some of the aquatic insects play an important role in mosquito control to a large extent (Service, 1965; Ellis and Borden, 1970). Venkatesan and Jeyachandra (1985) showed that *D. indicus* feeds on mosquito larvae and this acts as an active biological control agent. The predatory capacity of *D. indicus* was higher than that of a few well known larvivorous fishes.

The attack rate and handling time of *D. indicus* depended on water temperature (Sivagnaname 2000). The number of *Culex* larvae predated by the V instar larvae of *D. indicus* increased as a function of water temperature up to 35°C beyond which the predatory efficiency started declining. Further the developmental period also decreased as a function of increasing temperature.
Nebeker (1971) based on his studies on the influence of water temperature on the emergence of aquatic insects from streams found that increased temperature hastened the emergence of aquatic insects. Further he found that nymphal feeding rate and adult longevity increased as a function of increasing temperature in the stone fly *Pteronarcys aborsata*. Even in dragonfly nymph the temperature influenced feeding (Pandian *et al.*, 1979).

The fact that increased temperature increases feeding efficiency may be due to the increased active metabolism as reported by Macleord and Pessah (1973). Chapman (1971) is of the view that temperature regulates metabolic process directly by affecting the rate at which biochemical reactions take place.

The studies of Spence *et al.* (1980) has relevance to the rearing of aquatic insects in the laboratory. They found that temperature thresholds for development differ, both among species and often among stages of a particular species. Instars of *Gerris* species showed distinct optimum temperature for laboratory survival which varied with developmental threshold.

The V instar of *D. indicus* showed the maximum predatory efficiency and lowest developmental period at 35°C which may form the basis for the laboratory mass culture of *D. indicus*. 