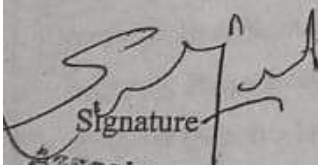


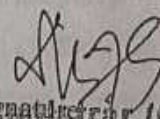
Utilization Certificate

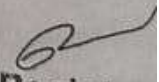
1. Title of the project: Polymorphism in Zooplankton of Jammu waters
2. Sanction Order no. RA/23/8110-8117 dated 8/3/2023
3. Name of the PI: Dr. Sarbjeet Kour
4. Department: Department of Zoology, University of Jammu
5. Total Project Cost: Rs. 2,00,000
6. Statement of Expenditure:

Head	Total grant released	Total expenditure incurred (INR)	Unspent Balance (INR)
Hiring of Services/Honorarium for experts	NA	NA	NA
Purchase of Minor Equipment	1,30,000/-	1,30,000/-	0/-
Consumables/Chemicals/Glassware	30,000/-	29,102/-	898/-
Contingency	20,000/-	18,473/-	1,527/-
Field work	20,000/-	20,000/-	0/-
Total	2,00,000/-	1,97,575/-	2425/-

Certify that out of Rs. 2,00,000 (Two Lakhs only) of Grant-in-aid, sanction vide order no. RA/23/8110-8117 dated 8/3/2023 in favour of Dr. Sarbjeet Kour (PI), a sum of Rs. 1,97,575/- has been utilized for the purpose of research for which it was sanctioned and the balance of Rs. 2425/- remained unutilized.


Signature
Associate Professor
Department of Zoology
University of Jammu
JAMMU


Deputy Registrar (Grants)
University of Jammu
Deputy Registrar
22/4/24


Registrar
University of Jammu
Joint Registrar

In order to survive the harsh and unfavorable environmental conditions, zooplankton adapt themselves by developing some morphological features. Cyclomorphosis is a temporal (seasonal or occasional), cyclic or induced morphological change that occurs in the planktonic population primarily as a result of impact of abiotic or biotic factors. Cyclomorphosis develops to a variable degree within different populations of the same species. These phenotypically different forms of species are known as morphotypes. Organisms can produce cyclomorphic variability in the tropical and subtropical regions as there is sufficient temperature difference among the seasons which initiate a cascade of variations both biotic and abiotic. Among several assumptions that were put forth to explain its ecological significance, most researchers suggested that cyclomorphosis probably acts as an adaptive strategy against potential predators (both vertebrates and invertebrates) or as a phenomenon involved in maintaining and stabilizing buoyancy of organisms in the water column.

morphic changes in the plankton populations have been documented in dinoflagellates, rotifers, copepods and cladocerans. The common changes in growth form in rotifers include the following: Reduction in size, bodywall enlargement with the formation of outgrowths or humps and production of lateral spines. Presently, different morphotypes have been observed for 4 species of rotifers belonging to family Brachionidae viz., *Brachionus calyciflorus*, *Brachionus bidentata*, *Brachionus quadridentatus* and *Keratella tropica*. *Brachionus calyciflorus* appeared in two different forms namely *Brachionus calyciflorus* f. *calyciflorus* (without postero-lateral spines) and a long spined form *B. calyciflorus* f. *amphiceros*. *Brachionus bidentata* was present in two morphotypes i.e. without posterior spines and with two postero-lateral spines. *Brachionus quadridentatus* existed in three different morphotypes namely *Brachionus quadridentatus* f. *quadridentatus* (two long convergent postero-lateral spines present), *B. quadridentatus* f. *cluniorbicularis* (without postero-lateral spines) and *B. quadridentatus* f. *melhemi* (postero-lateral spines long and divergent). Interestingly, all the different morphotypes of genus *Brachionus* were noticed to be co-occurring with one another. Genera *Keratella* also existed in two different forms viz., *Keratella monstrosa* (single right postero-lateral spine) and *Keratella asymmetrica* (short left and long right postero-lateral spine present). Similar polymorphic forms of rotifers were also recorded by Shvetambri (2011) in her study from Jammu waters.

Various authors have postulated that spine induction in *Brachionus* is a defense mechanism associated with chemical secretions/kairomones released by predator *Asplanchna* sp. (Gilbert and

Waage, 1967). In the present investigation, occurrence of long spined forms of *Brachionus calyciflorus* in presence of predatory rotifer *Asplanchna brightwelli* also hints about the effect of *Asplanchna* induced kairomones in induction of spines and appearance of this form. All morphotypes of *B. quadridentatus* were seen co-occurring with each other. Most probable reason behind the emergence of long spines in *B. quadridentatus* can be due to change in food or as a defense response to crustacean predators like *Mesocyclops leuckarti*. Form variation in *Brachionus bidentata* can be attributed to low temperature since morphotypes of this species were also observed co-occurring during colder months. The morphotypes of *Keratella tropica* were never seen together; the form *monstrosa* appeared in high number during different seasons of the year at station IV (Kanjak di Chhapadi) while form *asymmetrica* occurred during colder months at station V (Bhatyari pond). Such form variation in this species can be attributed to morphometric difference of the two stations as well as combined effect of physico-chemical and biological parameters such as available food and coexisting biotic community of predators and competitors. Authors like Green (1977) have already related variation in rotifer morphology with morphometric conditions of the lake.