*Trends in Biosciences 12(19), Print : ISSN 0974-8431, 1241-1246, 2019*

# A Generalized Approach to Male Genital System in Two Spider Species of Genus Neoscona

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## ABSTRACT

**In the present study, we highlight the male genital system of two locally available species of Neoscona spider. The male genital system in Neoscona spider consist of one pair of very large testes and convoluted vase deferentia which become thicker near the genital opening and fused distally to form the ductus ejaculatories. The genital tract is located ventrally in the ophisthosoma and the testes extend as far as to the spinning apparatus. Parts of testes and the vasa deferentia are bordered ventrally by the ampullate silk glands. The genital system is surrounded by extensions of the midgut gland. Exploring genital structures contribute to future phylogenetic studies as well as will stimulate much needed evolutionary studies of genital organization in spiders.**

**Keywords** *Generalized Approach, Male Genital System, Spider Species, Genus Neoscona*

The order Araneae is large group of animals which is commonly known as spiders. Araneae is subdivided into the ancient Mesothelae (segmented abdomen) and the derived Opisthothelae (un segmented body). Opisformthothelae can be subdivided into two lines, the paraphyletic Mygalomorphae and all true spiders, the Araneomorphae. Araneomorphae makeup 90% of all spiders. Araneomorphae can be divided into a small group, the Haplogyne, and a much larger group, the Entelegyne. Haplogyne have simple reproductive organs (Burger *et al*., 2006). Entelegyne spiders have more complex reproductive organs (Coddington, 2005) Spiders are web producing and eight legged. Spiders are worldwide distributed except Antarctica, sea and air. Spiders can be easily found in small area, spiders are of different sizes, colors with different habitat. The pioneering contribution on the taxonomy of Indian spiders is that of eropean arachnologist (Stoliczka, 1869).

The anatomy of spiders includes many characteristics shared with other arachnids. These characteristics include bodies divided into two segments, eight jointed legs, no wings or antennae, the presence of chelicerae and pedipalps, simple eyes, and an exoskeleton, which is periodically shed. All spiders are capable of producing silk of various types, which many species use to build webs to ensnare prey. Most spiders possess venom, which is injected into prey (or defensively, when the spider feels threatened) through the fangs of the chelicerae. Male spiders have specialized pedipalps that are used to transfer sperm to the female during mating. Many species of spiders exhibit a great deal of sexual dimorphism.

Spiders have separate sexes. Aside from a few exceptions (the water spider Argyroneta; Schütz and Taborsky, 2005), the females are larger than the males. Spider reproduction is characterized by many special traits (Eberhard, 2004). For example, spider males evolved a singular method of transferring sperm into the female by exploitation of pedipalps which are modiûed into secondary copulatory organs. These so called palpal organs are not innervated and lack sense organs as well as muscles possible consequences of this unique genital morphology were recently discussed in a review paper by Eberhard and Huber (2010). The complexness of the palpal organ can reach from straightforward (pyriform) kind as in mygalomorph spiders to extremely organized forms as in most

A- Male *Neoscona theisi*

B- Male *Neoscona sinhagadensis*

C-Male Reproductive structure in *Neoscona theisi*

D-Male Reproductive structure in *Neoscona sinhagadensis*

Plate 1. Morphology of male genital organs in genus *Neoscona*

entelegyne spiders (Kraus, 1984; Coddington, 1990). The copulatory organs are not directly associated with the primary genital system, which is located in the opisthosoma. The seminal ûuid (spermatozoa and secretion) is extruded from the gonopore and transferred into the so-called spermophor (tube-like invagination) of the palpal organ by employing a sperm web as a carrier, which results in a temporary exposure of the sperm to the environment (Foelix, 2011). In the majority of spiders, the spermophor is porous and surrounded by a glandular epithelium (e.g. Lopez, 1987; Suhm *et al.,* 1996). The mechanism of sperm induction and expulsion during copulation is still not clear. It was assumed that capillary forces or resorption of secretion discharged into the spermophor before sperm induction plays a task during this process (e.g. Lopez 1987; Suhm *et al.* 1996).

First, description of the primary male genital system of spiders was given by (Bertkau, 1875). According to his description the genital system consists of paired tubular testes and thin deferent ducts. The deferent ducts are fused near the genital opening

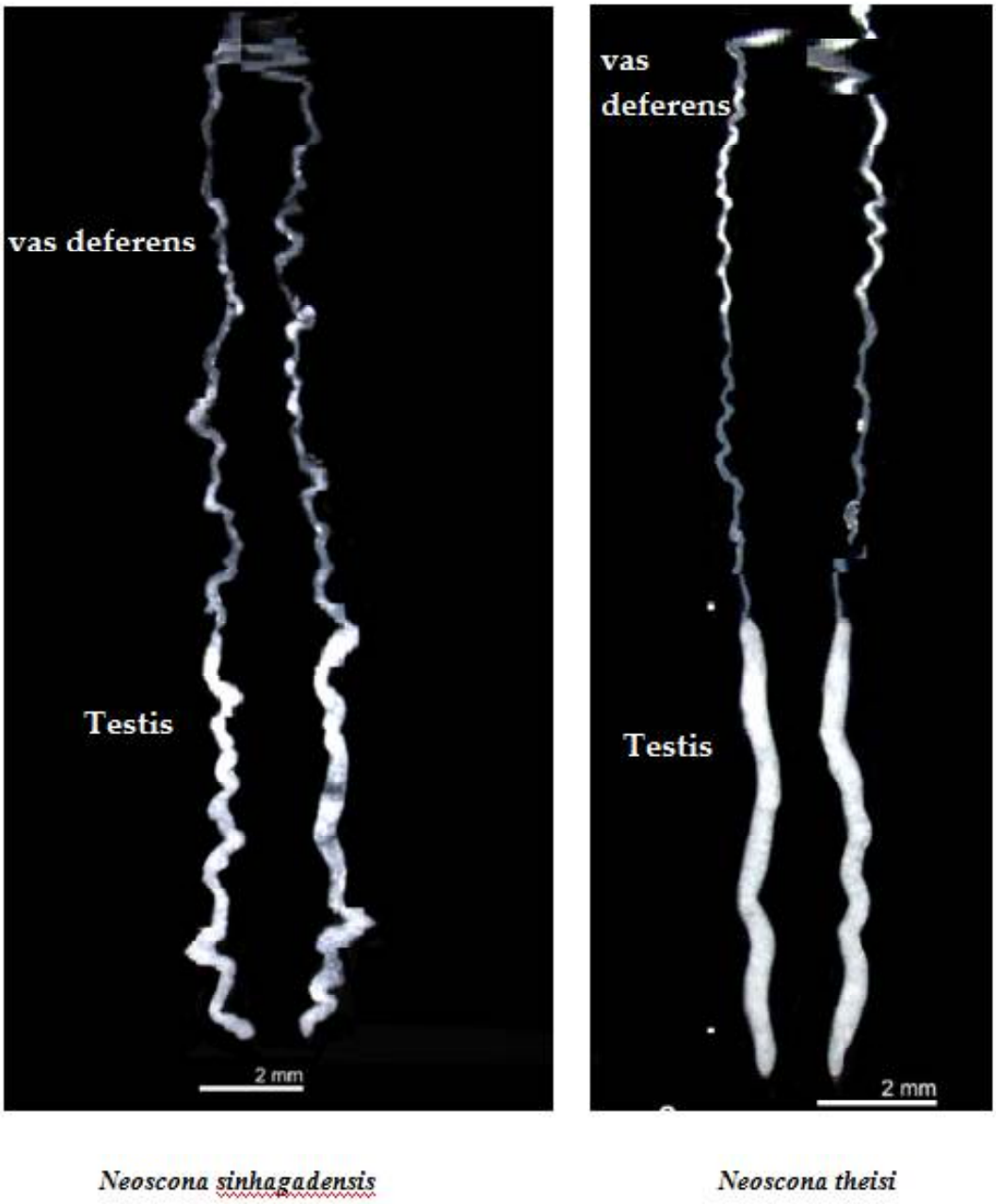


Plate 2. Extended male genital organs in Neoscona

forming the ejaculatory duct, which opens into the gonopore in the epigastric furrow. Accessory glands as known from Amblypygi or Uropygi are lacking which might be the result of the evolution from indirect sperm transfer with spermatophores to direct sperm transfer using the palpal organs (Alberti, 2005). Consecutive studies revealed a considerable diversity in the organization of the male genital system. For example, the testes can be fused distally (Mesothelae) (Michalik 2007), proximally (Atypidae, Segestriidae, Dysderidae and Scytodidae) (Bertkau, 1878; Michalik 2009) or completely (synapomorphy of Oonopidae) (Burger and Michalik 2010). The deferent ducts can be short or highly convoluted (Michalik 2009) and in some taxa with modiûed parts, as, e.g. so called ampullae in the sicariid Loxosceles intermedia (Costa-Ayub and Faraco 2007) or vesicles in the dictynid Nigma ûavescens (Michalik, 2009). The ejaculatory duct is usually inconspicuous, but can be enlarged as the seminal vesicle in theridiids (Knoûach, 1998; Michalik 2009) or widened towards the deferent ducts as in the philodromid Philodromus dispar (Crome,

1951). The function of these different structures is not known, but it can be assumed that temporary sperm storage might occur in those areas. The architecture of the spider male gonads reûects the general organization known for animals (White-Cooper *et al.,* 2009). The spider testis consists of spatiotemporally arranged spermatogenic cells at different developmental stages which are embedded in the somatic tissue (e.g. Alberti and Weismann 1985). Spermatogonia and early stages of spermatogenesis are located in the periphery, whereas late spermatids and spermatozoa are present in the central part of the testis (e.g. Michalik *et al.*, 2006). All stages of spermatogenesis are present resulting in a heterogeneous appearance of the testis. The somatic (epithelial) cells bear microvilli at the apical pole and are attached to each other by septate junctions and zonulae adhaerentes. Furthermore, the somatic cells are characterized by a high number of Golgi, endoplasmic reticulum and vesicles indicating a high secretary activity (e.g. Alberti and Weinmann 1985; Alberti and Coyle 1991).

## MATERIAL AND METHOD

During 2015-16 spider fauna of the genus *Neoscona* was surveyed from local area of Akola district and sampling was done. Different method is used for sample collection like, visual search, direct hand picking and jerking method. The species *Neoscona* are nocturnal in habitat so collection done during night time and after collection they are transferred into small plastic vials and brought into laboratory for identification and documentation.

### Identification

The specimen were identified based on structures and taxonomic key character, and followed by Tikader (1975, 1987), Majumder (2004), Gajbe (2008) and Platnick (2013).

For dissection the live freshly collected specimen are kept for few minute in refrigerator at $0^0$ C so that they go in chill coma. These specimens are then dissected out under Carl Zeiss stereomicroscope. Dissected male reproductive organs are then observed and photographed.

## Observation and Discussion

The reproductive organs in spider is found not very complex. In *Neoscona* theisi and *Neoscona sinhagadensis* (***plate 1***) species one pair of testes lie parallel to one another in anterolateral part of abdomen, below alimentary canal between the ventral body wall and the longitudinal ventral muscles. They are two long tubes which are closed behind, and are continued in front as two, long, thin, and often much coiled sperm ducts, the vasa deferentia shown in Plate 2. The two vasa deferentia open into a common pouch, the seminal vesicle and the seminal vesicle opens in turn through a single opening on the middle line of the body in the epigastric furrow Of the palpal organ. There is no copulatory organ directly connected with the outlet of the reproductive glands; but the seminal fluid is transferred to the female at the time of the pairing of the sexes by means of a highly specialized appendage of the palpus of the male as shown in Plate 1.

The genital tract is located ventrally in the opisthosoma and the testes extend as far as to the spinning apparatus. Parts of the testes and the vasa deferentia are bordered ventrally by the ampullate silk glands. The genital system is surrounded by extensions of the midgut gland. . This organization is reported from many species of different families, e.g., Cybaeidae, Theridiidae and Agelenidae, and seems to be the general condition in araneomorph spiders. In some species, e.g., the cybaeid *Argyroneta aquatica*, the testes are curved but distinct from the vasa deferentia . Petrunkevitch suggested that the few data available indicate a potential for systematic interpretation. A general rule for haplogyne spiders is that during copulation, the male inserts the palp bulb into the female genital opening with sperm deposition in the seminal receptacles (Foelix, 1996, Uhl, 2002, Michalik *et al.,* 2005). For members of some spider genera like Grammostola and Acanthoscurria (De Carlo, 1973), and for spider genera (Costa and Pérez-Miles, 2000), it was demonstrated that sperm cells are directly deposited by the male pedipalp embolus deep into the spermathecal receptacles. For for many such apiswea the male bulb is likely to be inserted

inside the genital opening, reaching the uterus externus and sequentially in the spermathecal stalk and bulb. Here we concluded that the primary male reproductive system and spermatozoa in general are highly diverse (Pitnick *et al*., 2009) and have been shown to be phylogenetically informative for a variety of animal taxa (e.g., Jamieson *et al.,* 1999; Giribet et al., 2002; Marotta *et al.,* 2008). Studies liked this will not only contribute to future phylogenetic studies but will also stimulate much needed evolutionary studies of reproductive systems in spiders.

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*Received on 25-09-2019 Accepted on 03-10-2019*