AGRIBLOSSOM
www.agriblossom.net
A monthly peer reviewed e-magazine for Agriculture & allied Sciences

Unisexual Reproduction: An alternative strategy of reproduction in Insects

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Introduction

Insects exhibits a great diversity in reproductive modes, while the eggs of most insects require fertilization for development, the eggs of some species develop without fertilization. This phenomenon is known as parthenogenesis. (*partheno* - virgin + *genesis* - origin, from *gen* -, to be produced) (Suomalainen, 1950). Parthenogenesis envelops a variety of reproductive system and is regularly viewed as inseparable from "clonal proliferation". Surely, the central component of thelytokous parthenogenetic engendering is that maternal genomes are commonly gone on perfect through a progression of each female brood. It is imperative to underscore, notwithstanding, that there are types of automictic parthenogenesis in which recombination is conceivable, and that in pseudogamous parthenogenesis, mating is fundamental despite the fact that proliferation is basically clonal.

Based on sex produced

Thelytoky: Parthenogenesis in which all the unfertilized eggs form into females. Thelytoky permit females to pass along their effective genotypes to the entirety of their offsprings, produce only daughters amplifying the pace of increment and dispense with the need for finding or attracting mate. Orders with the highest frequency of strictly thelytokous species are the Thysanoptera, Psocoptera, Hemiptera (especially in the suborder Sternorrhyncha) and Phasmatodea. Some families of largest order having very high rates of thelytoky are also observed, such as weevils (Coleoptera: Curculionidae), bagworm moths (Lepidoptera: Psychidae) and chironmid midges (Diptera: Chironomida). Thelytokus insects also produce diploid offspring by two different mechanisms. The first and simplest is apomixes in which no meiosis of the egg occurs and the resulting female offprings are genetically identical save new mutation their mother. The second is automixis, in which meiosis occurs but diploidy is by duplicating the genome of the eggs before meiosis, creating a 4N cell, such that after meiosis diploidy is restored which occurs in Orthoptera and Coleoptera.

Arrhenotoky: Parthenogenesis in which the individuals that develop from fertilized eggs are male and the unfertilized eggs are female. Arrhenotoky is commonly referred to as “haplodiploidy”. In two orders (Hymenoptera and Thysanoptera), haplodiploidy is the only known system of reproduction. Haplodiploidy also seen in some insect families such as scale insect (Hemiptera: Margarodidae), whiteflies (Hemiptera: Aleurodidae), some bark beetles (Curculionidae). In arrhenotokous Hymenoptera, females determine whether or not to fertilize an egg by controlling the release of sperm from the spermatheca as eggs pass down the oviduct. This mechanism likewise gives a way the mother can control the sex proportion of her offspring.

An uncommon type of advancement in insects identified with arrhenotoky is hermaphrodism, where similar individual produces eggs and sperm and descendants develop by self fertilization. Self fertilization results in a loss of about 50% of the parent's heterozygosity in every generation. The only known insects are a few scale species in the genus *Icerya*. The grown-up populace comprises totally of hermaphrodites, which have diploid ovaries and haploid testes. At the point when a hermaphrodite larva hatches from the egg, all cells in its body are diploid, yet after a period haploid nuclei show up in the gonad. They form a core from which the testis develops, surrounded by the ovary. Oocytes undergo normal reduction division, but the spermatocytes, which are already haploid, do not.

Deuterotoky: Parthenogenesis where there is production of both males and females which is seen in cynipid wasp (Hymenoptera: Cynipidae).

Based on Meiosis

Apomictic: The apomictic (or ameiotic) parthenogenesis takes place without meiosis which is characterized by the absence of recombination of alleles. A new individual that develops from unfertilized eggs are considered "full clones" and are genetically identical to the parent that produced them. It is the simplest form of parthenogenesis (Suomalainen, 1987).

Automictic: In automictic (or meiotic) parthenogenesis, the oocyte undergo meiosis, but eggs having half number of chromosome nonetheless develop without being fertilized by sperm. The mechanism that restores egg's diploidy is by duplicating the genome of a single cell or by fusion of two different cells which have genetic implications, as the parthenogenetic offsprings are considered "half clone" and they differ from one another and from their mother. To preserve the parent's entire genome with all of its heterozygosity, the entire genome may be duplicated before meiosis which is known as "premeiotic doubling" which is seen in Orthoptera and Coleoptera or it can happen when two products off meiosis I fuse which is seen in Collembola and Lepidoptera. Enforecement of homozygosity across the entire genome occurs when the haploid eggs nucleus divides and then fuses again which is known as "gamete duplication' seen in some Orthoptera, Hemiptera, Lepidoptera, Diptera and Hymenoptera.

Based on occurrence

Obligate parthenogenesis: Parthenogenetic lineage where no means of gene exchange with other lineages, and no mans of reproduction other than parthenogenesis.

Cyclic parthenogenesis: Parthenogenesis in which involves an alternation of one generation of sexual reproduction with one or more generations of parthenogenetic reproduction. The best example is complex reproductive cycle of aphids, a type of homopteran insect which use thelytoky associated with viviparous reproduction throughout the summer which enables them to exploit assets and to create multiple generations developing enormous populaces. In pre-winter aphids use amphigony alongside oviparous reproduction to produce overwinter in eggs (Davis, 2012).

Facultative parthenogenesis: Individual which can reproduce by amphigony, but if the males are absent, the unmated females can produce a viable parthenogenetic offspring. It has been observed that in some groups of insects where sexual reproduction is the mode of reproduction, but if a clutch of eggs is left unfertilized for sufficiently long, a small proportion of them will begin development. This type of parthenogenesis is often called as tychoparthenogensis is rather common in mayflies (Ephemeroptera) and in some polyneopteran orders (Orthoptera, Blattodea, Phasmatodea and Mantodea) and also occurs in Psocoptera, Lepidoptera and Diptera. The proportion of eggs that develop successfully into adults is low, often extremely low; hatching of unfertilized eggs of tychoparthenogenogenetic species may varies from 4 to 8%, but caught in the wild *Drosophila mercatorum*, the chance of an unfertilized egg developing is only about 1/10,000. The cytology of tychoparthenogenesis is always automictic.

Mating-Dependent Systems

Thelytoky is portrayed by absence of mating; for sure, the principal sign that an insect species may be parthenogenetic is the perception that no males exist in assortments. In pseudogamy which is also known as gynogenesis is a sperm-dependent parthenogenesis where mating with males of the same or a different species is necessary; egg development is initiated by contact with or penetration by sperm. After passage into the egg, paternal chromosomes degenerate and just maternal chromosomes survive in the offspring. This process can be viewed as pseudofertilization since offspring grow clonally, and all will be female, and is consequently hereditarily a type of parthenogenesis. Pseudogamy is hard to watch, since mating happens; it is normally found by taking note of that mated females consistently produce every single female brood. In insects, pseudogamy is discovered distinctly in Coleoptera (two origins in *Ips* bark bugs and one types of ptinid insect), two species of Lepidoptera, and in one species each one from Collembola, Orthoptera, and Homoptera.

In hybridogenesis, the paternal genome is avoided during oogenesis with the end goal that ova have just maternally determined chromosomes. The intact maternal genome is combined in each new age with sperm from male of an explicitly repeating host animal category. Such hemiclonal proliferation was first found in vertebrates, and to date is known in just the sort Bacillus (request Phasmatodea). In spite of the fact that classed alongside pseudogamy as "sperm-dependent parthenogenesis", it is really a crossover type of reproduction; it consolidates sexual reproduction regarding spermatogenesis, with non-recombinant, clonal maternal genomes.

Conclusion

The study of parthenogenesis can light up one of the focal issues in science, that of clarifying the universality of sex and recombination, and the versatile significance of the laws of hereditary qualities, by uncovering when and where in nature the laws of hereditary qualities are suspended or ousted. Insects because of their short life cycles and regularly enormous populace numbers are ideal organisms for examining the evolutionary and ecological results of parthenogenesis.

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