Journal of Advances and Scholarly Researches in Allied Education
Vol. XIV, Issue No. 2, January-2018, ISSN 2230-7540

Reviewed Study on Reproductive, Floral Biology and Pollination

Ankita Mani Tripathi[1]* Dr. Kamakshi Saxena[2]

[1] Department of Botany, Sunrise University, Alwar, Rajasthan, India

[2] Department of Botany, Sunrise University, Alwar, Rajasthan, India

Abstract – Pollination biology plays a crucial role in phylogeny. Pollinator shape and floral evolution results in the interaction between plants and pollinators, which is thought to be driven force in the evolution of flower. Foraging nature of pollinator is affected by the flower morphology. Long-tongued pollinators favor to visit the flower with longer corolla tubes to get more food and thereby carrying higher amount of pollen to bring effective pollination. Successful pollination is due to floral adaptation of pollinators to a particular type of flower. Thus, sometimes a particular plant species depends on particular type of pollinators for successful pollination, which indicates the co-evolution between flowers and pollinators. Sometimes reduction in population size results in decreased fruit as well as seed set due to insufficient pollen transfer. Small size population may be less attractive by the pollinators. Moreover, ecological interactions between pollinators and plants are mutualistic, because they yield a direct positive gain in fitness to both. Pollinators obtain a source of nutrition from plants during visit to flowers and intern transport pollen. Interaction between plants and animals is essential to maintain the biodiversity. Plant pollinator interaction is vital for maintaining the structural and functional integrity of natural ecosystem, because our prime strategies are to conserve the flora and fauna.

Keywords: Pollination, Pollinator, Plants, Flowers, Animals, Floral, Biology, etc.

----------X----------

I. INTRODUCTION

The knowledge of flower morphology, anthesis, pollen morphology, pollen viability, stigma morphology and its receptivity have a paramount importance in pollination biology. The knowledge of pollination biology of most tropical plant species is still unknown. In India, there is very little information regarding the pollination biology of flowering plants. There are several factors like temperature, relative humidity and rainfall which influence the pollination mechanism. As angiospermic flowers vary greatly in structure and morphology, different types of pollinators have been adapted. Sex expression is closely associated with the transfer of pollen grains as most of the angiosperms are hermaphrodite which is also helpful in assessment of evolution of plants. The anthesis and pollen release are important criteria for subsequent dispersal and pollination. In order to utilize the plant species in a judicious way as a resource, a thorough knowledge about the reproductive need including floral biology and pollination is required. Pollination biology is a recently developed branch in biological sciences and has attracted the attention of the scientist throughout the world because of its importance in understanding plant breeding system, floral evolution, foraging theory, animal behaviour, co-evolution etc. The principal events occurring during the reproductive growth of seed plants are initiation of flower primordia, maturation of floral parts, development of pollen grains within anthers, development of embryo sac, pollination, compatibility, pollen-stigma interactions, fertilization and formation of fruits and seeds. Pollination biology is a promising and multidisciplinary subject which includes diverse aspects of interest on plant-pollinators interaction.

There are essentially two different kinds of pollination, self-pollination and cross-pollination which always involves two plants with different genetic constitution. Vast gaps are there in our knowledge of breeding system of many plants and the pollination mechanisms involved still exist and there is an urgent need to undertake such studies in every plant family. Such a need is much more intended in our country where there is dearth of even basic data on ecology and floral biology of the particular taxon. Pollination is an important and essential stage in the reproduction of flowering plants. It involves the transfer of pollen from anther (male part) to the receptive stigma (female part) of the flower. The transference of pollen from an anther to a stigma is a powerful trigger that sets into motion a chain of fascinating events. The pollen

donation and the latter by fruit and seed production of plant by diverse agents such as wind, water, insects of various kinds, birds and other animals is an important and intricate mechanism.

II. REPRODUCTIVE BIOLOGY IN PLANTS

Sreekala A. K. (2017) Plant regenerative biology is the investigation of mechanisms and procedure of sexual and asexual reproduction in plants. It might include an examination on pollination mechanisms, gene flow, genetic variation and propagule dispersal between and inside populaces. Information on regenerative mechanisms of plants can evaluate the versatile noteworthiness and homology of unmistakable characters utilized in plant systematics. Contemplating regenerative biology can likewise give understanding into the delimitation and grouping of species and infraspecies. Hence, definite data on the conceptive biology of plants is fundamental for creating successful methodologies for their conservation and sustainable use. Pollination is an essential advance in conceptive achievement, species assorted variety and wellness of flowering plants. Pollinators assume an essential job in reproduction of plants in nature just as in agribusiness. As per ongoing appraisals, 87.75 % of the flowering plants are pollinated by animals, of which creepy crawlies comprise an enormous gathering. Plant-pollinator relationship is more than 100 million years of age. Plants and pollinators have co-advanced to create mutualistic adjustments. These developmental connections are currently being seriously influenced because of worldwide decrease in pollinators, brought about by environmental and anthropogenic aggravations.

Oliveira and Gibbs (2012) Fruit or seed dispersals are likewise generally connected with animals. Seed dispersal is a fundamental occasion for the plant to upgrade its populace measure in various good habitats and participate in forest enlistment. The accessibility of pollinators and seed dispersal, accept significance for the achievement of sexual reproduction in plants. Field perceptions and experimentation on assorted parts of pollination biology and seed dispersal environment are an absolute necessity, so as to understand the different complexities associated with plant-pollinator just as seed dispersal systems. This data is basic for the conservation and the executives of plant species and their needy animal species in both in situ and ex situ approaches. Concentrates in regenerative biology will likewise help in growing new systems to save the genetic capability of our plant species, which are significant for reclamation and reintroduction. The in situ conservation systems underscores on the security of common ecosystems for the conservation of generally speaking thickness of species and ecological procedures. The ex situ technique depend on professional flowerbeds, seed and dust banks, and germplasm banks to help save species outside the characteristic habitats. The ex situ approach discovers more application for financial plants where as the in situ approach for wild plants.

Cláudia and Helena (2017) expressed that the reproduction of tropical plants depends generally on their connection with animal pollinators and fruit and seed dispersers. Morphological and physiological highlights of the species associated with the connections must be adjusted so as to allow the fructification and to fit animal interests. The examination concerning these associations is of crucial significance to the understanding of the spatial circulation of plants in various ecosystems. The operators that perform pollination and dispersal may shift as per the plant species and the environment where it happens. Indeed, even inside a similar flat and vertical stratification of a forest, it is conceivable to discover variation in the plant populace and the animals related with it, both likewise impacted via regularity. The recognizable proof of the communications between organic variables, for example, animal and plant species, and non-natural elements, similar to rain and wind, causes us to expand the board and conservation plans for the ecosystems of the planet, which have turned out to be increasingly more fundamental along the most recent decades.

Oliveira and Gibbs (2010) expressed that the subject of regenerative biology manages the investigation of different associations occurring among plants and pollinators just as fruit/seed dispersers. The procedure of pollination is a basic occasion in the sexual existence of flowering plants. It speaks to a biotic mutualism essential to widely varied vegetation. Pollinator species are basic for commit out-crossers and notwithstanding for the vast majority of the self-pollinating plants. Decreases in pollinator networks or species, will effectsly affect sexual reproduction in plants. Pollination studies can give a ton of data about the loss of numerous species, since pollination is the major advance in plant reproduction. Plants have co-developed with their pollinators and huge ecological changes can decouple their harmonizing flowering and rearing cycles. In outcrossing entomophilous plants, populace size and plant thickness are intently connected with the fascination and action of pollinators. Generally little populaces are less alluring to pollinators and decrease in populace size outcomes in diminished fruit or seed creation because of inadequate dust move.

III. FLORAL BIOLOGY

Suwan Tangmitcharoenjohn and N. Owens (2017) Teak flowers are pitifully protandrous and pollen is shed inside a couple of long stretches of flower opening. Pollen is tricolpate and 29 µm in distance across. The papillate disgrace is of the wet sort and is responsive from 1100–1300h. The style is empty all through its length. Nectar and pollen are the major botanical prizes for pollinators. The significant pollinator's are Ceratinasp. which convey teak pollen on most pieces of their bodies, particularly the specific hair structures (scopal brushes) on the tibia. The best pollination time frame regarding flowers

pollinated and pollen per flower is somewhere in the range of 0900 and 1300h. At 1300h the quantity of pollen per flower is the most astounding, extending from 1–36 (normal 7). Pollen tubes become exceptionally quick. Inside 2 h after pollination 8% of the pollen tubes have achieved the micropylar finish of the ovule and pollen tubes initially enter the developing life sac at 8 h. Just one to two pollen tubes enter the micropyles of a flower. Albeit 78% of flowers were pollinated in open-pollination, the low fruit set (3.5%) recommends that there are factors other than pollination restricting fruit set. The primary factor seems, by all accounts, to be a high measure of selfing, and self-inconsistency happens when pollen tubes are captured at the lower segment of the ovary.

Leandro Freitas and Marlies Sazima (2009) Cross-and self-preparation in angiosperms are controlled by a few components, and an information of the instrument and time of unconstrained self-pollination offers open doors for a superior understanding of the advancement of mating systems and flower traits. The botanical biology of five species of Gentianaceae found in high-height neotropical grassland is introduced, with accentuation on the mechanisms that advance unconstrained self-pollination. An assumed botanical Batesian mimicry system is proposed between the uncommon and rewardless Zygostigma australe and Calydorea campestris, a species of Iridaceae with pollen-flowers, pollinated by syrphids and honey bees. The flower morphology of the other four gentian species focuses to three diverse pollination disorders: melittophily, phalaenophily and ornithophily. Notwithstanding, except for the nighttime Helia oblongifolia, flowers are nectarless and seem to show non-model beguiling mechanisms, giving comparable botanical prompts to some sympatric compensating species with a similar disorder. The comparative component of unconstrained self-pollination in Calolisianthus pedunculatus, Calolisianthus pendulus and H. oblongifolia (Helieae) depends on the stigmatic developments towards the anthers. Selfing is advanced by developments of the style/shame and of the corolla in Deianira nervosa and Z. australe (Chironieae), individually. The developments of stamens, style and disgrace during anthesis appear to be simply the most well-known technique for unconstrained pollination in angiosperms. It is proposed that the advancement of postponed unconstrained self-pollination would be progressively expected in those taxa with dichogamous flowers related with herkogamy. Such a trademark is visit in seemingly perpetual flowers of specific gatherings of Asteridae, which involve most archived instances of self-sufficient selfing. Hence, the nearness of dichogamy related with herkogamy (which as far as anyone knows advanced because of choice to advance both division of male and female capacities and the effective exchange of cross pollen) might be the initial phase in the versatile development of postponed selfing to give regenerative confirmation.

Blochtein et al (2014) Planning the artificial pollination of farming crops requires learning of the botanical biology and regenerative system of the yield being referred to. Numerous investigations have demonstrated that rapeseed (Brassica napus Linnaeus) is self-perfect and self-pollinated, however its efficiency might be expanded by creepy crawly appearance. In the present investigation, the flower biology and the reaction of profitability to creepy crawly appearance of two rapeseed cultivars (Hyola 420 and Hyola 61) were broke down and thought about in three districts of Rio Grande do Sul, Brazil. The rapeseed flowers introduced three phases during anthesis, with the timespans fluctuating between the cultivars. The two cultivars are self-good, however free appearance of creepy crawlies expanded efficiency by 17% in the Hyola 420 cultivar and by roughly 30% in the Hyola 61 cultivar. Subsequently, it is inferred that the cultivar Hyola 61 is more subject to creepy crawly pollination than Hyola 420.

IV. POLLINATION

Aronne et al. (2012) detailed the pollination mechanisms found in Fabaceae. The pollination mechanisms have been classified into four different types: explosive, valvular, piston and brush. In the explosive mechanism, the staminal column is heldunder pressure within the keel, and when the tension is released, the same column snaps forward against the standard petal causing all the pollen to be instantly released. This process is also known as tripping and it is generally accomplished when the keel is pressed down by a visiting insect. Further, a certain amount of tripping can occur without insect visits, due to heavy rain or high temperature that weaken the turgidity of the restraining keel tissues. Once tripping has occurred, the staminal column does not return into the keel. In the valvular mechanism the upper rim of the keel is moved downwards by the pollinator and closes when the insect leaves the flower. In this case pollen can be released repeatedly to numerous visitors. In the piston mechanism, the keel tip moves under the pressure of the insect while anthers and stigma keep their place. Pollen is released from the anthers and pushed out through a hole in the keel tip. It can be dispersed with repeated visits. In the brush mechanism, as the pistil is longer than the stamens, the stigma extends beyond the anthers, avoiding self-pollination, the upper part of the style develops erect trichomes acting as a pollen brush. When sufficient pressure is exerted on the standard and wing petals, the pistil protrudes from the keel tip; the stigma comes first into contact with the insect receiving (if present) external pollen and the style bushes the pollen on the visitor. When pressure is released, style and stigma return to their former position inside the keel.

Etcheverry et al. (2011) stated that the evolution of pollen and ovule number, and thus the pollen/ovule

ratio depend on both intrinsic and extrinsic factors. Among the intrinsic factors are the sexual system, evolutionary history, plant size, rewards offered, flowering time, life form, pollination mechanisms and pollen presentation, among others. Among the extrinsic factors are pollen vectors (groups and availability), nutrient availability, herbivory and location of populations within the species' range of distribution (periphery versus central) among others. The P/O ratio varies among plants depending on the floral rewards offered. Flowers offering nectar and pollen, or only pollen, as a reward tend to have higher P/O ratios than those offering only nectar as a reward for pollination services. Species offering only pollen as a reward produce it in great quantities because it is necessary to compensate for the amount of pollen consumed by pollinators. In contrast, species with special pollen-transporting structures such as pollinia, viscin threads, polyads have lower P/Os than species lackingthese structures because pollen aggregation enhances pollen transfer efficiency. Wind-pollinated species produce a much higher P/O than their insect-pollinated relatives because wind is a less efficient mechanism for pollen dispersal than insects, such that a high number of pollen grains are lost during the process. The P/O from animal pollinated plants depends on the mechanism of pollen presentation. In plants with primary pollen presentation, pollen is delivered directly from the anthers to the vector's body. In plants with secondary pollen presentation, pollen grains are delivered first on a floral part such as the keel petals in Papilionoideae and then on the body of the vector implying an accurate delivery of pollen on the vector's body, efficient pollination and a low P/O.

Pollen morphology has paramount importance in pollination and identification was critically done by Erdtman (2006) following acetolysis methods. Different morphotypes of pollen grains, their shape, size, and aperture and exine ornamentations have a paramount importance in the success of pollination of angiosperms. Total number of pollen/anther/flower (Pollen productivity) as well as the total number of pollen grains per inflorescence was counted by Mandal and Chanda (2011). Ovule quantity and Pollen-ovule (P/O) ratio are also important parameters to study the contribution of pollen towards fertilization of an ovule. Thus, relative abundance of pollen available for the ovules of a flower can be achieved to explain the barriers of successful pollination and stigma receptivity.

Role of pollinators was first observed on a particular plant species by Sprengel (2013) and from where it has been investigated that flowers have an adaptation in order to attract the pollinators for pollination success. In order to access nectar from flower, insect may adapt themselves, which carried out successful pollination. Such adaptation has driven the term ‘pollination syndrome’ in broader sense in relation to plant-pollinator interactions. Pollination syndrome i.e. morphological, chemical and other traits of floral adaptation are developed to attract specific pollinator for a particular plant species. Such view of pollination syndrome was enormously explained by Faegri and van der Pijl (2010). Sometimes deceit pollination have found in some plant species, where pollinators mistakenly visit the flower due to mimic. Deceit pollinations are of three types: pseudocopulation, interspecific mimicry and intersexual mimicry and are common in the family Apocynaceae, Caricaceae, Ebenaceae, Myristicaceae and Orchidaceae.

Maues et al., (2008) Breeding system is important to determine whether the plant is autogamous or allogamous. Self-sterility and compatibility within the plants can be measured through breeding programme like geitonogamy and xenogamy. Pollination ecology is important to study the effectiveness of specific flowervisitors as pollinator in relation to morphological adaptation of a flower that ensure optimal fertilization for reproductive success, which is an interesting finding under pollination biology. Morphology of reproductive organ or flower phenology and their influence to attract the pollinator to fruit and seed set are important observations in the study of interaction between plant and pollinator.

Arceo-Gomez et al., (2011) [8] Polymorphism in mirror-image flower of Chamaecristachamaecristoides of Fabaceae is particularly dependent on buzz pollinators, which induces greater pollination success. Floral biology of Aechmeanudicaulis of Bromeliaceae has been carried out in the Atlantic rain forest of Southern Brazil. Floral characteristic of this supports ornithophily, where humming bird is the main pollinator and bees are the additional pollinators. But, both of the pollinators are guaranteed for successful pollination.

CONCLUSION

Regenerative biology is significant for understanding the structure and decent variety of networks just as the ecological association of plants and their pollination and dispersal specialists. Botanical biology means every one of the indications of the life of the flower locale. The flowering phase in plants, regardless of its morphological and physiological complexities speaks to a temporary phase among vegetative and regenerative parts and is of incredible noteworthiness from the view purpose of fruit and seed arrangement. The auxiliary element of flower, which is a steady attribute and the learning about the botanical biology including pollination are critical in reproduction and rearing projects. The issue on pollen move has broadly various perspectives, regardless of whether the vector is an animal or lifeless physical power. Abiotic pollination is an inefficient procedure as the exchange is non-directional, then again in biotic pollination a subsequent organism is fundamental and a relationship is built up between the pollinating operator and bloom to be pollinated. As angiosperms advanced, creepy crawly pollination turned into a significant factor in their transformative expansion.

REFERENCES

1. Aronne, G., Giovanetti, M. and De Micco, V. (2012). Morphofunctional traits and pollination mechanisms of Coronillaemerus L. flowers (Fabaceae). The Sci. World J. Article ID 381575, 8 pages.

2. Etcheverry, A.V., Aleman, M.M., Figueroa-Fleming, T., Lopez-Sphar, D., Gomez, C.A., Yanez, C., Figueroa-Castro, D.M. and Ortega-Baes, P. (2011). Pollen: ovule ratio and its relationship with other floral traits in Papilionoideae (Leguminosae): an evaluation with Argentine species. Plant Biol. (Stuttg.) 14: pp. 171-178.

3. Erdtman, G. (2006). Pollen Morphology and Plant Taxonomy. Hamer Publishing Company, New York, USA, pp. 380.

4. Mandal, S. and Chanda, S. (2011). Aeroallergens of West Bengal in the context of environmental pollution and respiratory allergy. Biological Memoirs, 6: pp. 1-61.

5. Sprengel, C. K. (2013). Das entdeckteGeheimniss der Nature imBau und in der Befruchtung der Blumen (The secret of nature in the form and fertilization of flowers discovered). Berlin.

6. Faegri, K. and van der Pijl, L. (2010). The Principles of Pollination Ecology. Pergamon Press, Oxford, UK.

7. Maues, M. M., Oliveira, P. and Kanashiro, M. (2008). Pollination biology in Jacaranda copaia (Aubl.) D. Don (Bignoniaceae) at the "FlorestaNacional do Tapajos", Central Amazon, Brazil. RevistaBrasileira de Botânica, 31(3): pp. 517-527.

8. Arceo-Gomez, G., Martinez, M. L., Parra-Tabla, V. and Garcia- Franco, J. G. (2011). Anther and stigma morphology in mirror image flowers of Chamaecristachamaecristoides (Fabaceae): implication for buzz pollination. Plant Biology, 13 (Suppl. 1): pp. 19-24.

9. Cláudia Inês da Silva and Helena Maura Torezan Silingardi (2017). "REPRODUCTIVE BIOLOGY OF TROPICAL PLANTS" INTERNATIONAL COMMISSION ON TROPICAL BIOLOGY AND NATURAL RESOURCES

10. **Sreekala A. K. (2017) "**IMPORTANCE OF PLANT REPRODUCTIVE BIOLOGY IN CONSERVATION" https://www.researchgate.net/publication/314364124

11. Oliveira, P. E. & Gibbs, P. E. (2010). Reproductive biology of woody plants in a cerrado community Central Brazil. Flora 95: pp. 311-329. [Contribution on the reproductive biology of tree species in cerrado]

12. Oliveira, P. E. & Gibbs, P. E. (2012). Pollination and reproductive biology in cerrado plant communities. In: Oliveira P.E. & Marquis R.J. (eds), The cerrados of Brazil: ecology and natural history of a Neotropical savanna. Columbia University, New York, pp. 329-347.

13. Suwan Tangmitcharoenjohn and N. Owens (2017). "Floral Biology, Pollination, Pistil Receptivity, and Pollen Tube Growth of Teak (*Tectona grandis*Linn f.)" olume 79, Issue 3, March 2017, Pages. 227-241

14. Blochtein, B.a*, Nunes-Silva, P.a , Halinski, R.a , Lopes, LA.b and Witter, S.c (2014). "Comparative study of the floral biology and of the response of productivity to insect visitation in two rapeseed cultivars (Brassica napus L.) in Rio Grande do Sul" http://dx.doi.org/10.1590/1519-6984.02213

15. Leandro Freitas and Marlies Sazima (2009). "Floral biology and mechanisms of spontaneous self-pollination in five neotropical species of Gentianaceae" Botanical Journal of the Linnean Society, 2009, 160, pp. 357–368.

Corresponding Author

Ankita Mani Tripathi*

Department of Botany, Sunrise University, Alwar, Rajasthan, India