AgriCos e-Newsletter
ISSN: 2582-7049
Volume : 01 Issue : 05 September 2020 Article No: 26

Molecular Mechanism and Models of Flower Development in Plants

Yengkhom Linthoingambi Devi
Ph.D. Scholar, Genetics and Plant Breeding, College of Agriculture, IGKV, Raipur, Chhattisgarh

SUMMARY

The reproductive structure of a plant is a flower which is required for the propagation of the plant. The biological function of flower depends on the floral structure which will decide the strategy for reproductive methods, genetic diversity, pollen dispersal, pollinator interaction reproductive isolation, etc. Flowers may provide outcrossing which is the fusion of the sperm and the eggs from different individuals in a population or allow selfing which is the fusion of sperm and egg from the same flower. A flower has mainly two essential parts- the vegetative part and the reproductive part. For the transition of plant to happen, changes in the hormone level, seasonable temperature and photoperiod changes are necessary prerequisite factors. The molecular interpretation of these signals is through the transmission of complex signals called, florigen which includes a list of genes like constans, flowering locus C and flowering locus T. Knowing the molecular basis of flower development is helpful in several crop improvement work. The proposed models have several applications.

INTRODUCTION

A flower is the reproductive structure of a flowering plant which is responsible for the propagation of the plant. The biological function of flower depend on the floral structure which will decide the strategy for reproductive methods, genetic diversity, pollen dispersal, pollinator interaction reproductive isolation, etc. Flowers may provide outcrossing which is the fusion of the sperm and the eggs from different individuals in a population or allow selfing which is the fusion of sperm and egg from the same flower. A flower has mainly two essential parts- the vegetative part and the reproductive part. For the transition of plant to happen, changes in the hormone level, seasonable temperature and photoperiod changes are necessary prerequisite factors. The molecular interpretation of these signals is through the transmission of complex signals called, *florigen* which includes a list of genes like *constans,* flowering locus C and flowering locus T. Leaves are the primary producing site of florigen and act upon buds and growing tips to direct a number of different physiological and morphological changes. The biological changes happen led to the cellular differentiation of leaf, bud and stem tissues into tissues for reproductive organs.

Structural Organization of Inflorescence Meristem and Origin of the Flower Meristem:

During the vegetative phase, the shoot apical meristem produce leaves on its flanks and the shoot bolts on transition to flowering and the shoot apical meristem becomes the inflorescence shoot apical meristem. The primary inflorescence meristem produce lateral meristem which will produce flower or secondary inflorescence. The shoot apical meristem is organized into three different zones which is central zone, peripheral zone surrounding the central zone and the rib zone underneath the central zone. Peripheral zone will give flower primordial while the rib zone gives rise to stem tissue. The central zone maintains itself and yields daughter cells that form both the peripheral zone and the rib zone.

Molecular Genetics of Flower Development:

Florigen is the main signal that initiates flowering in plants. Recently, it was revealed that molecular nature of florigen is governed by a protein named FT, which act as a systemic floral signal in case of Arabidopsis and *Hd3a* in case of rice. Both the genes are expressed in the phloem of leaves when day length of flower promotion are given which is long day condition for Arabidopsis and short day condition for rice. *Hd3a* promoter is active in the phloem of the leaf blade under short day condition and *Hd3a* mRNA is detected only from the leaf blades. It was shown that the translated *Hd3a* protein moves from leaf phloem tissue to the shoot apical meristem. Transgenic plants with increased amount of FT/*Hd3a* flowered earlier and plants with less FT flowered later. In the model study of Arabidopsis, it was found that the transcription factor, FD, interacts with FT to form transcription complex that activates *APETALA1* which is floral identity gene. Besides this, some genes are also involved in the floral transition: which are *FLOWERING LOCUS T (FT), LEAFY (LFY), SUPPRESSOR OF OVEREXPRESSION OF CONSTANS1(SOC1).*

ABC Model of Flower Development:

In this model, flower development is governed by three genes which are A, B and C. A function is responsible for the formation of sepal, A along with B gene responsible for the formation of petal, B along with C from the stamen and the C alone makes the carpel. Examples of A gene *APETALA1 (AP1)* and *APETALA2 (AP2)* in case of Arabidopsis. *SQUAMOSA (SQUA)* and *LIPLESS (LIP1)* and *LIPLESS2 (LIP2)* in case of *Antirrhinum.* B gene function found in the two genes of Arabidopsis which are *APETALA3 (AP3*) and *PISTILLATA (PI)*. C function gene found in *AGAMOUS (AG)* of Arabidopsis. *PLENA (PLE)* gene is present in *Arabidopsis majus*. There are also genes which are exhibiting type D and E function. Type D involve in the development of ovules while type E involved in the development of three innermost verticils, however later it was found that its expression was required in all the floral verticils.

Mutations in ABC Gene and its Effect on Plants

Mutation in the A gene affect the calyx and corolla, which are the outermost verticils. In this mutation, carpels are developed in place of sepals and stamen in place of petals.

Mutations in B gene affect the corolla, and the stamen, the mutation cause development of sepals instead of petals and carpels in place of stamen

Mutations in type C gene affect the reproductive verticels, it leads to a phenotype containing petals instead of stamen and sepals instead of carpels.

CONCLUSION

Knowing the molecular basis of flower development is helpful in several crop improvement work. The proposed models have several applications. Some are- mutation of the B gene involve in the development of male sterile line for hybrid seed production programme. Mutation in the C gene can be used for the development of double flower in case ornamentals. Mutation in D gene controls seed and fruit shattering. Thus it can be applied in several studies by knowing its molecular nature.

REFERENCES

Alvarez-Buylla E.R., Benítez M., Chaos A., Espinosa-Soto C., Padilla-Longoria P., Balleza E. Gene regulatory network models for plant development. *Curr. Opin. Plant Biol*. 2007;108(1):83–91.

Alvarez-Buylla E.R., Garcia-Ponce B., Garay-Arroyo A. Unique and redundant functional domains of APETALA1 and CAULIFLOWER, two recently duplicated Arabidopsis thaliana floral MADS-box genes. *J. Exp. Bot*. 2006;578(1):3099–3107.

Becker A., Theissen G. The major clades of MADS-box genes and their role in the development and evolution of flowering plants. *Mol. Phylogenet. Evol.* 2003;298(1):464–489.

Robert W. Allard 1999. Principles of plant breeding. John Wiley & Sons publisher, America.

Tsuji, H. 2017. Molecular function of florigen. *Breed. Sci*., 67(4):327-332.