International Journal of Botany Studies
www.botanyjournals.com
ISSN: 2455-541X
Received: 20-08-2021, Accepted: 05-09-2021, Published: 20-09-2021
Volume 6, Issue 5, 2021, Page No. 706-708

Extension of inflorescence axis into vegetative shoot: Pineapple an interesting example

Deshmukh S A[1*], M M Aitawade[2]
[1] Department of Botany, The New College, Kolhapur affiliated to Shivaji University, Kolhapur, Maharashtra, India
[2] Department of Botany, Sharadchandra Pawar Mahavidyalaya, Lonand, Maharashtra, India

Abstract
At the onset of flowering, in most of the plants the shoot apical meristem (SAM) modify into inflorescence meristem (IM) which further switches to floral meristem (FM). In most of the flowering plants the SAM is totally consumed for the production of flowers thus the reproductive shoots doesn't continue further into the vegetative shoots. But the general observation of pineapple enlighten the focus on the trend that he SAM is either not totally consumed or FM is again converted to SAM resulting in the production of pup at the top of inflorescence axis.

Keywords: pineapple, SAM, IM, FM

Introduction
The flowering plants in their life, produces flowers after completing the vegetative growth and perception of appropriate photoperiod leading to the of requisite photo inductive cycles. Such transition from vegetative to reproductive phase is very interesting and complex physiological aspect. During such a decisive event the shoot apical meristem (SAM) which prior functions for the production of vegetative buds (*viz.* leaf, stem, axillary buds) change its role flamboyantly and start to produce the floral buds. Through the course of conversion from vegetative to reproductive, the SAM modifies itself into inflorescence meristem (IM) and later into floral meristem (FM). In most of the phanerogams the SAM is totally utilized for the production of peduncle and the flowers and thus after formation of the peduncle the vegetative growth is stopped and further vegetative growth continues at the leaf axils by the axillary sympodial SAM [1]. Cunha (2005) [2] discussed flowering process of pineapple plants, including notions about general flowering physiology, pineapple inflorescence, natural and artificial flowering in pineapple. He also focused on several substances which are involved in vegetative growth of plant.

Ananas (pineapple) belongs to the monocotyledonous family Bromeliaceae. Pineapple is the most economically important crop owing second rank subsequent to banana as important tropical fruit in the international trade [3]. The plant in its life cycle passes through three different overlapping phases such as vegetative phase, generative phase and propagative phase [4]. In case of pineapple interesting feature is observed, the SAM continues its role into pup formation after the production of inflorescence. That means in pineapple the SAM is not completely consumed for the production of inflorescence instead it switches itself to its main function i.e. production of vegetative plant parts *e.g.* leaves (pup) along the margins of inflorescence axis. In such case the role of SAM is very dynamic as it converts itself into IM later to FM which anon convert back to SAM.

Probable Reasons for the Development of Pup

Survival of the Plant under Adverse Environmental Conditions
Pineapple is a xerophyte showing CAM pathway of photosynthesis and has adapted itself by many means against adverse environmental conditions such as drought by producing spirally crowded leaves showing lesser stomatal density. Again the stomata are covered with trichomes which check the rate of transpiration. The leaves also possess water storage tissue where water is stored to escape through the drought situations. This peculiar structure of the leaves also help the plants for better survival during frost conditions. Pineapple is with self incompatibility and hence the sexual reproduction in pineapple is very rare thus the plant reproduces mainly by vegetative propagation by means of slips, suckers, hapa and the crowns [5, 6, 7]. Under such circumstances the production of leaves *i.e.* pup at the top of inflorescence axis broaden a mean for the survival and continuation of the plant's race.

Production of Leaves for Continuation of Photosynthesis
In pineapple, flower induction leads to the cessation of leaves [8].

Defoliation in pineapple before harvesting causes reduction in total soluble sugars in the fruit [9]. In general, at the maturity of the inflorescence the leaves either shed off or get dried on the pineapple plants. Thus the rate of photosynthesis decreases. As the carbohydrates are the end products in photosynthesis and in case of pineapple are stored in peduncle. Thus the development of the leaves at the top of the inflorescence axis might be helping in enriching the carbohydrate content of aggregate fruit. Also the pup at the top might be functioning to provide shade to the fruit by restricting direct exposure to the sunlight and give protection.

Role of Phytohormones
Phytohormones and transcription factors assist to steadiness the maintenance of meristem and organ production [10].

It is well known that the florigen leads to floral evocation but still the hormone is not isolated and characterized. Another phytohormone i.e. gibberellins has flower induction activity which has been proved in plants like *Arabidopsis* [11], *Bryophyllum* [12] and many gymnosperms. It also has been reported that the levels of gibberellins increases in plants at the time of flowering. A characteristic stimulus shown by the members of family Bromeliaceae *e.g.* pineapple, where the flowering is induced a great deal by the endogenous production or external application of the ethylene [13]. In pineapple the inflorescence axis rachis might be functioning for storage, formation or conduction of a phytohormone which again forms the vegetative shoot. Such conversion of SAM to IM to FM and again back to the SAM is very interesting. Various phytohormones might be functioning for such conversion.

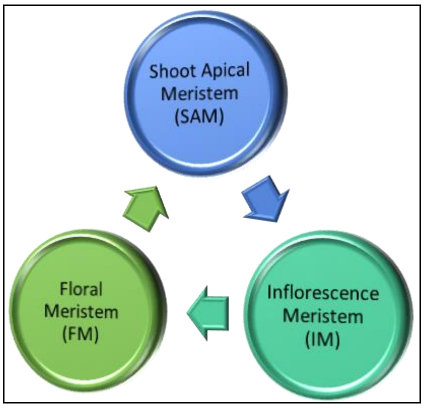

Fig 1: schematic representation of inter conversion of meristems in pineapple

Role of Specific Genes

Certain genes functions for the transition of vegetative phase to reproductive phase. Actually the genes which suppress the formation of terminal flower lead the formation of inflorescence meristem. In Snapdragon the terminal flower formation is suppressed by the expression of *CEN* (centroradialus) gene [14]. In *Arabidopsis*, *LFY* (leafy), *AP1* (apetala) and *CAL* (cauliflower) genes identify floral meristem and also bring about the conversion of inflorescence meristem to floral meristem [15]. Li *et al.* (2016) [16] showed that four ethylene receptor genes *viz. AcERS1a*, *AcERS1b*, *AcETR2a* and *AcETR2b* play important roles during pineapple flowering induced by exogenous ethephon. By considering these aspects related to genetic constitution of the flowering, it can be probably outlined that, in pineapple the genes which functions for formation IM and its conversion to FM and at later phase of the development reverse their expression for the formation of vegetative shoot forming SAM. In such case we may conclude probable cyclic expressive nature of the genes.

Summary and Conclusion

The research paper enlightens the probable reasons responsible for the production of pup over the inflorescence axis. The various reasons (*viz.* environmental factors, production of leaves for special purpose, role of phytohormones and the specific genes) might be functioning for the said cause. But in this study a very interesting aspect can be noted which demonstrates the cyclic reversible expression nature of the genes *i.e.* from SAM to SAM *via* intermediate expressive check points *i.e.* IM and FM. Further detailed studies related with this will be helpful to solve this interesting aspect.

Acknowledgements

Author is very much thankful to Dr. P. D. Chavan, Dr. D. K. Gaikwad (Head, Department of Botany, Shivaji university, Kolhapur), Dr. B. B. Nalvade and Dr. A. S. Nigwekar for their promise to brilliance and the peak proficient principles. I am also thankful to The Principal, The New College, Kolhapur and the staff members, Department of Botany, for their support and encouragement.

References

1. Yuste-Lisbona FJ, Quinet M, Fernandez-Lozano A, Pineda B, Moreno V, Angosto T *et al.* Characterizationn of vegetative inflorescence (mc-vin) mutant provides new insight into the role of Macrocalyx in regulating inflorescence development of tomato. Sci Rep,2016:6:18796.
2. Cunha GAP. Relationship among growth regulators and flowering, yield, leaf mass, slip production and harvesting of 'Pérola' pineapple. Acta Horticulturae, Wageningen, 2005, 149-160.
3. Coveca. Comision veracruzana de comercializacion agropecuaria, Gobierno Del Estado de Veracruz, Mexico, 2002.
4. Fassinou HVN, Lommen WJM, Agbossou EK, Struik PC. Heterogeneity in pineapple fruit quality results from plant heterogeneity at flower induction. Frontiers in Plant Science,2014:5:1.
5. bioweb.uwlax.edu/bio203 by Meagan Engebos.
6. Coppens d'Eeckenbrugge, G Duval MF, Van Miegroet F. Fertility self incompatibility in the genus Ananas, Acta Horticulturae,1993:334:45.
7. Hepton A. Cultural system, in The Pineapple: Botany, Production and Uses, eds Bartholomew DP, Paull RE, Rohrbach KG, editors, (Wallingford: CABI Publishing), 2003, 109.
8. Bartholomew DP, Malezieux E. Pineapple, in Handbook of Environmental Physiology of Fruit Crops, eds Schaffer B, Andersen PC, editors, (Boca Raton, FL: CRC Press), 1994, 243.
9. Chen C, Paull RE. Sugar metabolism and pineapple flesh translucency. J Amer Soc Hort Sci,2000:125:558.
10. Shani E, Yanai O, Ori N. The role of hormones in shoot apical meristem function, Cur Opin Plant Biol,2006:9:484.
11. Blazquez M, Weigel D. Integration of floral inductive signals in Arabidopsis. Nature,2000:404:889.
12. Zeevaart JAD, Halevy AH. Bryophyllum, Handbook of flowering. Boca Raton CRC Press Inc, 1985, 89.
13. Taiz L, Zeiger E. Plant Physiology, Vth (edit.) (Publ.) Sinauer Associates, Inc., Publishers, Massachusetts, 2010, 748.
14. Bradley D, Carpenter R, Copsey L, Vincent C, Rothstein S, Coen E. Control of inflorescence architecture in Antirrhinum, Nature,1996:379:791.
15. Blazquez MA, Soowal LN, Lee I, Weigel D. LEAFY expression and flower initiation in Arabidopsis, Development,1997:124:3835.
16. Li YH, Wu QS, Huang X, Liu SH, Zhang HN, Zhang Z *et al.* Molecular Cloning and Characterization of Four Genes Encoding Ethylene Receptors Associated with

Pineapple (*Ananas comosus* L.) Flowering. Frontiers in plant science,2016:7:710.