## Vivipary in greengram (Vigna radiata) and maize (Zea mays)

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Greengram (Vigna radiata L.) also known as mungbean belongs to the family Fabaceae. It is a short duration proteinrich grain legume crop grown in 23 countries of the world. It is mainly grown as a rainfed crop and suitable for a wide range of soil types. Apart from being an important source of animal feed and human food, greengram having an important role in sustaining soil fertility by atmospheric nitrogen fixation. Maize (Zea mays L.), a C4 cereal crop belongs to the family graminae. Across the globe today, maize is a staple food for millions of individuals, and it is also an essential component of global food security (Campos et al. 2004). Vivipary (live birth) in flowering plants can be defined as continual and precocious growth of offspring, when it is still attached to the parental parent (Goebel 1905), as this phenomenon is characterized by absence of seed dormancy (Baskin and Baskin 2001, Farnsworth 2004, Batygina and Bragina 2009). The term vivipary should be confined to the germination of seeds in situ without undergoing metabolic quiescence or resting period (Goebel 1905, Arber 1965, Font Quer 1993) and the germinated young seedling grows to a certain considerable length before detaching from the plant. Vivipary implies that seed formation and growth of sexually developed embryos are essential to the process (Farnsworth 2000) and this condition is better known in placental mammals, but it also occurs in several amphibians, insects, numerous reptiles, a few fish, and some plants (Cota-Sanchez et al. 2007). Vivipary has been reported in around 100 flowering plant families, which represents less than 0.1% of angiosperms (Farnsworth 2000).

In flowering plants, two main categories of vivipary have been described: true vivipary or generative vivipary and pseudovivipary or vegetative vivipary (Batygina and Bragina 2009) and that are categorized based on strength of the developed embryo to break through the seed coat. In true vivipary, plants will produce sexual offspring, where the embryo penetrates through the pericarp of the fruit and grows to a certain considerable length before it

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gets dispersed. In such cases, developing zygote lacks the maternal tissues, which mediate its relationship with the outer environment. In contrast to this, maternal tissues protect the zygote from adverse conditions in non-viviparous plants (Elmqvist and Cox 1996). An exception to embryonic penetration of the pericarp characterizes viviparous plants known as Cryptovivipary (a subcategory of true vivipary), a condition described by Tomlinson (1986). In Cryptovivipary, the zygote develops significantly but does not penetrate the pericarp before dispersal. The second type, pseudovivipary, involves the production of asexual or apomictic propagules such as plantlets or bulbils and this phenomenon is common in monocots, particularly in the Poaceae (Elmqvist and Cox 1996). Further, it is an asexual reproductive strategy in some of the arctic/alpine grasses (Pierce *et al.* 2003).

During the visit to the greengram field (var. BGS 9) during September 2020 (Dist. Gulbarga, Karnataka state,



Fig 1 Vivipary (True vivipary) in greengram.



Fig 2 Vivipary (True vivipary) in Maize.

India) and maize field in October 2020 (Dist. Haveri, Karnataka state, India), we have come across a seed germinating while still it is attached to the parent plant. This is due to the prevalence of continuous rainfall and higher humidity during the seed development period. So, the plants which exhibit this kind of germination are called as viviparous seeds. Further, it is considered as an ecological adaptation to unfavourable adverse environmental conditions like halophytic environment (Rabinowitz 1978) and moreover, it is also a common and natural phenomenon to escape physiological dry conditions adopted by certain mangroves (Majumder *et al.* 2010).

But in the case of greengram and maize, it is a way to economic loss as this kind of germinated seeds cannot be stored and marketed. Further, vivipary has been reported by many authors in many crops, viz. *Vigna radiata* (Ahmad *et al.* 2014); *Sorghum bicolor* (Roberto *et al.* 2018); *Hordeum vulgare* and *Triticum aestivum* (Nakuram 2017); *Glycine max* (Baize 2011); *Oryza* sp. (Mohapatra and Kariali 2016); *Solanum lycopersicum* (Cota-Sanchez J H 2017) and we are reporting vivipary (true vivipary) in greengram and maize. Earlier, in maize, it has been reported by Durantini *et al.* (2008). But as per the literature survey, we are the first to report vivipary (true vivipary) in greengram.

We believe that, vivipary in greengram (Fig 1), maize (Fig 2), and various food crops are due to the occurrence of wet weather as a result of frequently occurring rainfall during the seed development period and this led to changes

in hormonal concentration (ABA and GA) and exhibits vivipary. This unusual phenomenon of vivipary may be a useful character in the greening of barren lands and afforestation projects (Deore and Johnson 2008), as it is self-propagated in some crop plants like mangroves. It can be concluded that vivipary in greengram is due to heavy moisture accumulated in seeds because of heavy rainfall for a longer duration, which ultimately deteriorates the quality of seeds.

## **SUMMARY**

In angiosperms, if high rainfall coincides during the seed development period, hormonal imbalance occurs in seeds (ABA and GA), this hormonal imbalance leads to escape the dormancy, and thereby, seeds germinate on the plant itself. This unusual kind of germination is known as vivipary and based on strength of the developed embryo to break through the seed coat, two kinds of vivipary have been categorized, viz. True vivipary and Cryptovivipary. Certainly, this kind of germination will make a way for loss in seed quality. Nevertheless, vivipary is the reproductive strategy adopted by mangroves and this advantageous character can be helpful in the greening of barren lands.

## REFERENCES

Ahmad S, Khulbe R K and Roy D. 2014. Evaluation of mungbean (*Vigna Radiata*) germplasm for pre-harvest sprouting tolerance. *Legume Research* **37**(3): 259–63.

Arber A. 1965. *The Gramineae. A Study of Cereal, Bamboo, and Grass.* J. Cramer-Weinheim, New York, pp. 1–480.

Baize J C. 2011. Brazil soybeans-germination in the pod. The U.S. Soybean Export Council. https://sites.psu.edu/38cmeg/2011/03/17/brazil-soybeans-germination-in-the-pod/.

Baskin C C and Baskin J M. 2001. Seeds-Ecology, Biogeography and Evolution of Dormancy and Germination. Academic Press, San Diego.

Batygina T B and Bragina E A. 2009. Vivipary. *Embryology of Flowering Plants*. Batygina T B (Ed). *Reproductive systems* **03**: 19–29.

Campos H, Cooper J E, Habben G O, Edmeades and Schussler J R. 2004. Improving drought tolerance in maize: A view from industry. *Field Crops Research* **90**: 19–34.

Cota-Sa'nchez J H, Reyes-Olivas A and Sa'nchez-Soto B. 2007. Vivipary in coastal cacti: a potential reproductive strategy in halophytic environments. *American Journal of Botany* **94**: 1577–81.

Cota-Sa'nchez J H. 2017. Precocious Germination (Vivipary) in Tomato: A Link to Economic Loss?. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences 88: 1443–51.

Deore A C and Johnson T S. 2008. Occurrence of vivipary in *Jatropha curcas* L. *Current Science* **95**: 321–22.

Durantini D, Giulini A, Malgioglio A, Pilu R, Tuberosa R, Sanguineti C and Gavazzi, G. 2008. Vivipary as a tool to analyze late embryogenic events in maize. *Heredity* **101**: 465–70.

Elmqvist T and Cox P A. 1996. The evolution of vivipary in flowering plants. *Oikos* 77: 3–9.

Farnsworth E J. 2000. The ecology and physiology of viviparous and recalcitrant seeds. *Annual Review of Ecology and* 

- Systematics 31: 107-38.
- Farnsworth E J. 2004. Hormones and shifting ecology throughout plant development. *Ecology* **85**: 5–15.
- Font Quer P. 1993. Diccionario de Botánica. Labor S A (Ed), pp. 1–1244. Barcelona, España.
- Goebel K. 1905. Organography of Plants, Especially of the Archegoniatae and Spermophyta. Part II. Clarendon Press, Oxford, pp. 1–707.
- Majumder S, D'Rozario A and Bera S. 2010. Vivipary in Indian Cupressaceae and its ecological consideration. *International Journal of Botany* **6**: 59–63.
- Mohapatra P K and Kariali E. 2016. Management of viviparous germination in rice: a strategy for development of climate resilient rice cultivation. *Oryza* **53**(3): 235–39.

- Nakamura S. 2017. Grain dormancy genes responsible for preventing pre-harvest sprouting in barley and wheat. *Breeding Science Preview* **68**(3): 295–304.
- Pierce S, Stirling C M and Baxter R. 2003. Pseudoviviparous reproduction of *Poa alpina* var. vivipara L. (Poaceae) during long-term exposure to elevated atmospheric CO<sub>2</sub>. *Annals of Botany* **91**: 613–22.
- Rabinowitz D. 1978. Dispersal properties of mangrove propagules. *Biotropica* **10**: 47–57.
- Roberto L, Benech-Arnold, María V and Rodríguez. 2018. Preharvest Sprouting and Grain Dormancy in *Sorghum bicolor*: What Have We Learned?. *Frontiers Plant Science* 9: 1–8.
- Tomlinson P.B. 1986. *The Botany of Mangroves*. Cambridge Univ. Press, Cambridge.