‘Precocious’ Seed Germination in Turkish and Chinese Accessions of Sesame (*Sesamum indicum* L.) in Indian Conditions

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**Abstract:** A ‘precocious’/‘viviparous’ seed germination is reported in one Turkish and one Chinese accession of Sesame (*Sesamum indicum* L., family Pedaliaceae), an oilseed crop, for the first time. Both the mature and green pods of these accessions showed a peculiar ‘within pod’ germination of seeds in pot culture. Scanning Electron Microscopy of the placental zone of the immature pod revealed early cotyledon development of different stages, while magnified views of the germinated seedling from the mature pods depicted onset of multi cellular trichome and even the stomata. This unique and aberrant phenomenon of seed germination was correlated with environmental fluctuation associated with low dormancy of seeds.

**Key words:** Sesame • SEM • Vivipary

**INTRODUCTION**

Sesame (*Sesamum indicum* L.) is the most ancient oilseed crop known to human civilization as the oldest remnants of sesame, found in the Harappa valley in the Indian subcontinent; date the origin of these activities to at least 5500 BC [1]. The uniqueness of sesame plant is that it continues to produce leaves, flowers and capsules simultaneously as long as the weather permits unlike most other crops where onset of reproductive growth marks the cessation of vegetative growth. This indeterminate developmental phenomenon poses a serious problem in sesame cultivation since it is near impossible to accurately determine seed maturity as mature capsules near the base of the plant split and lose seed while flowering continues on the top of the plant. In fact, it is among the most important priorities for developing an improved plant type of sesame either through classical or marker assisted breeding approach and to convert sesame from a labor intensive crop requiring manual harvesting to a mechanized harvesting-compatible crop. This ‘shattering of seeds’ as a resultant of non synchronous pod maturity though is not preferred from the perspective of sesame breeding and cultivation but from the point of view of the plant itself, this wild trait(s) is of definite advantage to thrive and propagate in unfavorable condition.

While working on an ongoing programme of improvement of sesame through marker assisted breeding for last couple of years, the present group has developed a phenomic based algorithm to characterize seventy one germplasm of sesame procured from different parts of the world and has short listed few Indian and exotic accessions having unique assemblage of traits setting subsequent milestone of looking for genotype and trait specific molecular markers [2]. Two of these selected accessions (one from Turkey-accession number PI 175907 and the other from China-accession number PI 195122; both procured from USDA repository) while grown with the other accessions / varieties in the last season (2011) have shown a unique phenomenon of ‘precocious’ / ‘viviparous’ seed germination, which is being reported here.

**MATERIALS AND METHODS**

Seeds were sown in the month of March routinely both in field condition and earthen pots within net house. The crops were harvested within May to early June in field condition but the plants grown in pot culture were reared until July, mainly to study the indeterminacy and non synchronous growth habit of the crop critically, one of the major issues of sesame, which has been stated earlier. During the last week of June 2011, plants of both the accessions started to show a peculiar ‘within pod’ germination of seeds (Fig. 1a), which initially was an event of the till then non-shattered seeds within the matured
Pods, which have started to split, at least along one suture of pod ‘dehiscence zone’ (Fig. 1b). But, a curious observation of us at the end of June and early July 2011 revealed ‘precocious germination’ of almost all the seeds even within the ‘green pods’, which were yet to be mature and undergone the natural phenomenon of ‘shattering’ of seeds (Fig. 1c). These lead to examine this unique morpho-physiological event in detail.

Both the green and mature pods were harvested with extreme caution so that the tender seedlings attached to the placental tissue remained intact. These followed careful dissection of the pods and the placental zone with seeds (Fig. 1d); some in germinated and some in yet to be germinated condition; and were subsequently fixed, dehydrated through alcohol and alcohol: iso amyl acetate grading, critical point drying and sputter coating with gold (7 mA) following standard protocols of material fixation for Electron Microscopy [3]. Photographs were taken under FEI Quanta 200 MK2 Scanning Electron Microscope.

RESULTS AND DISCUSSION

The photo micrographs revealed unique ‘precocious’ nature of seed germination in different stages (Fig. 1 e-h) starting from green to mature pods. The placental zone of the immature pod showed early cotyledon development at stages (Fig. 1e) while the magnified view (Fig. 1f-h) of the germinated seedling from the mature pods depicted the onset of multi cellular trichome and even the stomata at higher magnification (photograph not shown).
The photographs of ‘control’ set of normally (epigeal) germinated seeds (in Petri plates) revealed onset of profuse root hairs only (Fig. 1i-j).

This unique and aberrant phenomenon of seed germination in two sesame accessions could plausibly be correlated with environmental fluctuation associated with low dormancy of seeds. The mean meteorological data of Kolkata, India collected from the webpage of Regional Meteorological Centre (http://www.imdkolkata.gov.in/) were plotted in form of histograms with trend line regression analysis. This revealed a sharp increase of rainfall during the period of this unusual observation accompanied with steady rise of relative humidity as well as maximum/minimum temperature (Fig. 2a-c). Further, the number of rainy days was twenty one each during the months of June and July 2011 (data not shown graphically).

Sesame, essentially, is a moderately drought resistant crop requiring less irrigation. Furthermore, farmers tend to harvest this crop of low cropping time prior to onset of rainy season so that shattering of seeds could be minimized to reduce yield loss.

Fig. 2a-c: Bar diagrams of mean data of rainfall (a), temperature (b) and relative humidity (c) during March-July 2011.
From the point of view of dormancy, sesame seeds exhibit low dormancy; and the position of pods on the plant and the degree of maturity affect dormancy (http://www2.bioversityinternational.org/publications/Web_version/52/ch41.htm#TopOfPage). Like mustard, the major oilseed crop [4], sesame too exhibits incidence of germination of ‘volunteer seeds’ from the split-open pods (photograph not shown). Hence, it could reasonably be extrapolated that due to prolonged stay in pot culture and perceiving the unfavorable environmental condition the seeds adopted an alternative way of thriving by germinating the seeds within the pods.

Now, the questions are: (1) why the other accessions/varieties did not adopt the same route of survival; and (2) is this a phenomenon of ‘viviparous germination? It is intricate to answer these questions at this material point of time; until and unless the progeny from the seeds of sesame germinated this way can be studied further. It is true that apart from the mangroves, which definitely adopted the phenotypic plasticity of ‘viviparous seed germination’ due to their unique ecological habitat [5, 6]; there are reports of stray ‘vivipary’ or ‘cryptovivipary’ in maize [7], *Jatropha* [8], Cactus [9] and *Capsicum* [10], to name a few. However, the issue is whether it is due to unknown ‘environmental noise’-induced phenotypic plasticity [11] or there is a definite QTL (Quantitative Trait Locus/Loci) involved in this trait, which can be trapped and investigated with state-of-art molecular techniques for improvement of cultivated crops in the backdrop of changing climatic scenario.

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**REFERENCES**