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# THE MORPHOLOGICAL CHANGES AND DRYMATTER ACCUMULATION IN THE DEVELOPING SESAME, *SESAMUM INDICUM* L. SEED DURING PROGRESSIVE EMBRYOGENESIS

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Dry matter accumulation pattern, moisture content and other morphological specifications were characterised through stereoscopic techniques. A distinct biphasic embryonic development comprising of seven different morphological stages was recognised in the developing seed of *Sesamum indicum* L. The linear phase of dry matter accumulation was taken for cotyledonary tissue to act as a nurse tissue for the growing embryo and simultaneously the flushing of metabolites was accounted for accumulation of the dry matter.

**Keywords:** Cotyledonary embryo; Embryogenesis; Endosperm; *Sesamum indicum;* Weight accummulated.

## Introduction

Several productivity constraints such as low and unreliable yields, shattering of capsule and indeterminate flowering pattern intensify the issue of how pod and seed growth and development are controlled in this important oil seed crop. For this the whole developmental phenomenon involving a sequential interaction of developing embryo - - > endosperm - - > somatic tissue of plant *via* placenta and funicle - - > the proximal leaf and pod wall needs a multifacet orientation[1-3]. The present study is helpful in elucidating the complexity of growth and development and the improvement of the developing seed tissue.

## Materials and Method

The present investigation was carried out using sesame cv RT-46. The seeds were procured from the Plant Breeder, All India Coordinated Research Project on Oil Seed-Sesame, Agricultural Research Station, Mandore (Jodhpur, Rajasthan). The plants were raised during kharif season of 1993 in plots (2x5m), maintained through the recommended cultural practises of irrigation and fertilization.

Particular flowers were tagged and the pollination was insured manually. Developing pods of 5, 10, 15, 20, 25, 30 and 35 DAF (Day After Flowering) from these flowers were used for evaluating embryo development and growth rate *in vivo*. The seeds were taken out and dissected for embryos of different stages which were subsequently examined for external morphology by the use of stereomicroscope. Simultaneously the developing seeds were also used for recording growth and development by taking fresh and dry weight at 5 DAF to 35 DAF.

## Results and Discussion

The progressive embryogenesis studied from 5-35 DAF in sesame showed a biphasic seven staged growth and development of cotyledonary embryos (Table 1). Dry matter accumulation in the zygote cotyledonary embryo was noticed in the growing tissue (Table 1) and the distribution and variation of dry weight (Fig. 1) provided convincing indicators of phasic separation of the developing embryo as also reported in *Datura* and *Capsella*[4]. The heterotrophic phase was comprised of only two embryonic stages *Viz.*, T-shaped proembryo (upto 5 DAF) and the

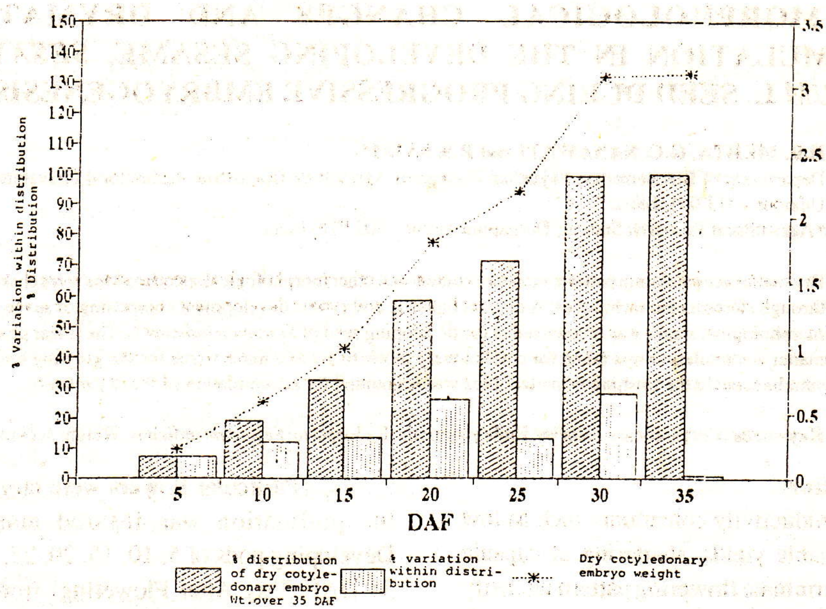


Fig. 1. Influence of growth and development on dry matter, % distribution and % variation with in distribution during embryogenesis.

early globular stage which lasted upto 10 DAF. The proembryo stage was found to form a four celled octant by transverse or vertical division of the apical cell. The next stages showed an increase in size and weight etc and was somewhat watery and semihard. These characteristics reflected a reduction in the fluidity of the endosperm suggesting a separation of zygote colyledonary embryonic sac. Such consequences indicate that the developing cotyledonary embryo might have consumed nearly the whole of the endosperm by the time[5,6]. All these observations correspond to the characteristics of the heterotrophic phase.

After the termination of heterotrophic phase at 10 DAF early globular stage of the next autotrophic phase in sesame started from late globular (15 DAF) stage and lasted upto torpedo shaped embryo stage at 30 DAF. A 4.5 to 14.0 fold increase in dry matter accumulation was noted during this phase over 5 DAF proembryo stage. The beginning of organogenesis of cotyledonary embryo and embryonic axis, presence of prominent dermatogen epidermis and faster growth of cotyledonary zone compared to plumular zone suggest the stimulus compiling response as characteristics of the autotrophic phase.

The extravagant enlargement of the zygotic cotyledonary embryo at 10 DAF stage as compared to 5 DAF resulted in the continuance of the linear phase (Fig 1) thus escaping the lag phase. This was accounted in terms of fast flushing out of metabolites from the endosperm into the developing cotyledonary tissue which is evidently increased dry matter accummulation. Subsequently the cotyledonary tissues act as

**Table 1.** Influence of growth and development on dry matter accumulation during embryogenesis.

| Days after flowering | Phase/Stage of embryo | Fresh weight/seed (mg) | Dry weight/seed (mg) | Moisture (%) | Fold increase in dry seed weight | Distribution (%) | Variation within distribution (%) |
|---|---|---|---|---|---|---|---|
| Heterotrophic | | | | | | | |
| 5 | Pro-embryo | 2.00 ± 0.41 | 0.22 ± 0.02 | 88.69 ± 1.54 | | 7.1 | 7.1 |
| 10 | Early globular | 5.27 ± 0.25 | 0.59 ± 0.05 | 88.72 ± 1.53 | 2.68 | 19.0 | 11.9 |
| Autotrophic | | | | | | | |
| 15 | Late globular | 4.34 ± 0.26 | 1.00 ± 0.16 | 76.72 ± 4.96 | 4.54 | 32.3 | 13.3 |
| 20 | Heart-shaped | 5.98 ± 0.19 | 1.80 ± 0.33 | 69.77 ± 5.81 | 8.18 | 58.1 | 25.8 |
| 25 | Early torpedo shaped | 4.76 ± 0.19 | 2.20 ± 0.16 | 53.49 ± 4.72 | 10.00 | 71.0 | 12.9 |
| 30 | Late torpedo shaped | 5.00 ± 0.41 | 3.07 ± 012 | 38.13 ± 6.77 | 13.95 | 99.0 | 28.0 |
| 35 | Somatic embryo | 4.90 ± 0.14 | 3.10 ± 0.08 | 36.64 ± 3.44 | 14.09 | 100.0 | 1.0 |

N.B : A = Fold increase in dry weight over initial at 5 DAF; B= % distribution calculated over final stage of embryo development at 35 DAF; C = % distribution variation calculated from difference of succeeding; % distribution over final stage of embryo development at 35 DAF; mean of three replications with standard error.

**Table 2.** Changes in size of cotyledonary embryo during different stages of embryogenesis.

| Days after flowering | Stages of embryogenesis | Area ($cm^2$) | Expansion ($cm^2$) | Reduction ($cm^2$) | Size of cotyledonary embryo | |
|---|---|---|---|---|---|---|
| | | | | | Expansion ratio | Reduction ratio |
| Heterotrophic | | | | | | |
| 5 | Pro-embryo | 7.64 | - | - | - | - |
| 10 | Early globular | 37.73 | 30.09 | - | 3.93 | - |
| Autotrophic | | | | | | |
| 15 | Late globular | 29.67 | - | 8.06 | 3.02 | 1.05 |
| 20 | Heart-shaped | 52.80 | 23.13 | - | - | - |
| 25 | Early torpedo shaped | 44.60 | - | 8.20 | 0.98 | 1.07 |
| 30 | Late torpedo | 52.14 | 7.54 | - | - | - |
| 35 | Somatic embryo | 44.29 | - | 7.85 | - | 1.02 |

N.B * 1. Expansion and reduction in cotyledonary embryo size based pro-embryo.
** 2. Ratio was calculated from area of pro-embryo over expansion and reduction in size.

a nurse tissue for the developing embryo. Likewise the conservative nature of the zygotic cotyledonary embryo in restricting development of the endosperm gives to nonedosperm seeds as has already been reported for Indian sesame species.[7]

To conclude these studies it was quite evident that the developing seed during embryogenesis accumulated as increased dry matter by a linear magnitude and thus bypassing lag and plateam phases and thereby indicating for cotyledonary tissue to act as a nurse tissue for the growing embryo. Simultaneously the larger intumesce followed by reduction with different rhythm animate the flushing of matabolites to accumulate dry matter in the growing cotyledonary embryo.

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