

# The Development of an Efficient Somatic Embryogenesis System in Potato

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## Rationale

The process of somatic embryogenesis, envisaging dedifferentiation and then redetermination of somatic plant cells towards the embryogenic pathway forming bipolar structures (somatic embryos) containing both root and shoot axes, is yet another way of exhibiting totipotency by plant cells. In potato (*Solanum tuberosum* L.), somatic embryogenesis offers a potentially novel method of producing basic seed material in an efficient manner. However, the development of somatic embryogenesis systems in potato is still at its infancy.

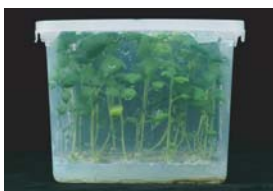
## Objectives

- To develop protocols for efficient somatic embryogenesis and synthetic seed production in *Solanum tuberosum* L.
- To evaluate the maintenance of uniformity among somatic embryogenesis regenerated plants (emblings).
- To identify molecular markers specific to somatic embryogenesis in *Solanum tuberosum* L.

### Stage-I

In vitro propagation for the availability of internodal segment explants.

3 week old in vitro potato cultures.



In vitro shoot culture

### Stage-II

Explants' culturing for the induction of somatic embryogenesis.

2,4-dichlorophenoxy acetic acid at 5  $\mu$ M was the most effective plant growth regulator (PGR) among all PGRs used.



Induced explant

## Methodology

Transfer of induced explants to different medium for the expression of induced somatic embryogenesis response.

## Results

Somatic embryogenesis response was visible within 2 weeks of explant culturing. Extending incubation for further 4-5 weeks was found optimum for obtaining large numbers of suitable-to-process size somatic embryos.

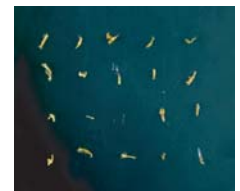


Emerging potato somatic embryos

### Stage-IV

Post emergence processing

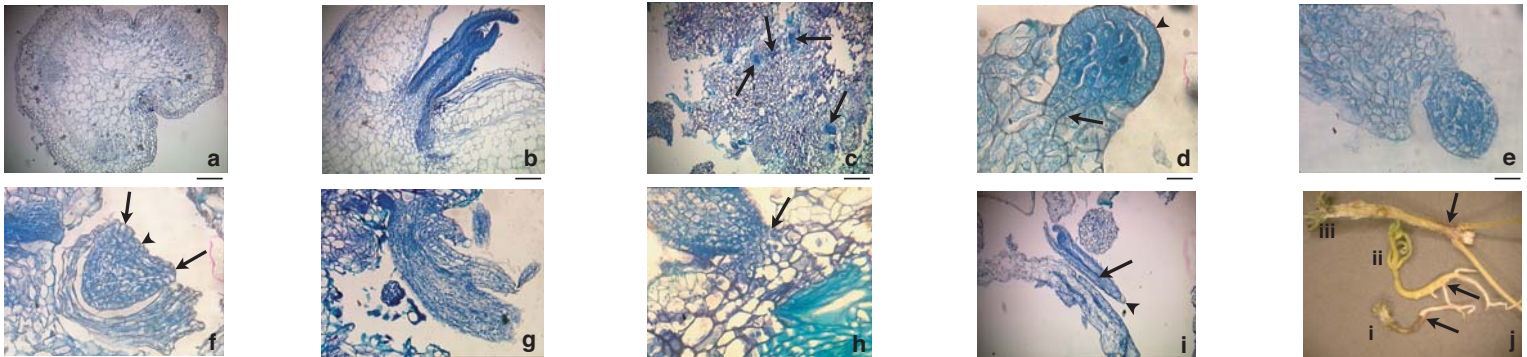
Reversible dormancy was induced in somatic embryos by PGR treatment in order to facilitate post emergence steps.



Dormant cv. Desiree somatic embryos

## Confirmation of Somatic Embryogenesis Pathway of Development

- Somatic embryogenesis in potato was confirmed using histological approach.
- Key developmental stages (globular, heart and torpedo) and features (presence of suspensor-like-structure, protoderm and discrete vascular system) characteristic to somatic embryogenesis were observed.



a, TS of stem internodal section showing intact anatomical features; b, an axillary bud with well developed vascular connection with mother explant; c, embryogenic zones (arrows); d, globular stage with visible protoderm (arrowhead) and a suspensor-like-structure (arrow); e, late globular stage; f, heart stage showing cotyledonary initials (arrows) and differentiating apical meristem region (arrow head); g, torpedo stage; h, somatic embryo with no visible vascular connection with mother tissue; i, a somatic embryo with closed basal end (arrowhead) and contained vascular system (arrow); j, a view showing potato embling (I), seedling (II) and microplant (III). Bars: Figure j = 1mm; figures a, b, c & i = 300  $\mu$ m; figure g = 120  $\mu$ m; figures e, f & h = 60  $\mu$ m; and figure d = 30  $\mu$ m

## Plant Conversion

- Growing emblings resembled seedlings for their small-rounded leaves, vine like growth, rooting pattern in contrast to growth features observed in microplants (figure-3j).
- Transplantation of emblings to glasshouse conditions resulted in potato plants and tubers with normal morphology.



Improved embling appearance



Somatic embryos grown to maturity

## Progress Summary

- A potato somatic embryogenesis system was established, developmental pathway confirmed by histology, somatic embryos converted to emblings and grown to full maturity in the glasshouse.

## Ongoing Work

- Further improve embryo maturation and plant conversion rates and develop efficient delivery methods through conventional and modified approaches.
- Identify potato 'Somatic-embryo-receptor-kinase' (SERK) ortholog and study its differential gene expression during key embryogenesis stages.



Possible potato SERK orthologs



Germinating potato synthetic seed

## Future Work

- Study global gene expression during the process of potato somatic embryogenesis.

## Reference

SK Sharma and S Millam Somatic embryogenesis in *Solanum tuberosum*: A histological examination of key developmental stages. Plant Cell Reports (in press).

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