SOMACLONAL VARIATION

Somaclonal variation is the genetic variability which is regenerated during tissue culture Such variations manifests themselves as heritable mutation and present in the plant population even after transplantation to the field. Larkin and Scowcroft (1981) proposed the term somaclone to describe the plants originating from any type of tissue culture. The somaclonal variation may be attributed to either I) pre existing variation in the somatic cells of the explants) or ii) variation generated during tissue culture)

Variation arise by specific culture of cells or tissues, which include culture of: protoplasts (protoclonal); anthers and microspores (gametoclonal); callus (calliclonal); apical meristem (mericlonal); leaf, stem, root or other somatic tissues (somaclonal).

Mechanisms causing somaclonal variation

1.endomitosis

2.chromosomal abberation

3.DNA amplification

4.transposable elements

5.point mutation



why or how these chromosomal changes occur?

1. alterations in DNA methylation

a decrease in methylation causes the genes more active

2.lack of nucleic acid precursors due to very rapid cell division

3.role of growth regulators like 2,4D and sometimes kinetin in inducing variation

4.nutrient composition

KNO3 influences the albino plants from wheat cultures , level of organic N2 chelating agents and other micro nutrients

5.Culture conditions: temperature , method of culture

1. duration of culture (longer the duration of culture more the variation)

Steps in Somaclonal Variation:

There are different steps to create somaclonal variation, which include:

1. growth of callus or cell suspension cultures for several cycles;

(2) regeneration of a large number of plants from such long-term cultures;

(3) screening for desirable traits in the regenerated plants and their progenies, e.g. *in-vitro* selection to select agronomically desirable somaclones for tolerance to various biotic and abiotic stresses using toxic levels of pathotoxins, herbicides, salts, etc.;

(4) testing of selected variants in subsequent generations for desired traits; and

(5) multiplication of stable variants to develop new breeding lines.

SELECTION OF SOMACLONAL VARIATION

1.analysis of phenotypic characters

the morphological characters of somaclones are compared with the parental types for three tof four generations and finally the genetic variability is assessed

2.cytological study of variants

3.mesurement of DNA content of the variants

4.gel electrophoresis of proteins and enzymes

1. by exerting selection pressure using particular chemicals in the media
   1. selection for disease resistance - the toxin produced by the pathogen can be used in the media ( phytophthora resistance in potato)
   2. herbicide resistance - by adding interested herbicide in the media ( tobacco)
   3. salt tolerance - by adding NaCl ( tobacco)
   4. drought/water logging tolerance - by adding PEG (tomato)
   5. mineral toxicity/deficiency tolerance - adding and reducing the quantity of interested nutrient in the media ( tomato, sorghum)
   6. temperature stress / chilling response - exposing the culture to very high or low temperature (tobacco for chilling response, pear for temperature stress)

Somaclonal variation among regenerated plants from callus and protoplast culture has been presented to a lot of significant contributions to plant science. Somaclonal variation among regenerated plants from

Callus and protoplasts culture has been suggested as a useful source of potentially valuable germplasm for plant breeding and improvement. The major benefit of somaclonal variation is to create variation in adapted genotype.

List of crop species where desirable and heritable somaclonal variation has been reported

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| Species | Characters which were modified |
| Allium sativa | Bulb size, shape, clove no. aerial bulbil |
| Avena sativa | Plant height, heading date, awns |
| Hordeum spp | Plant ht, tillering |
| Oryza sativa | Plant ht, heading date , seed fertility, grain no., wt |
| Saccharam officinarum | Disease (eye spot, fiji disease, downey mildew) |
| Triticum aestivum | Plant and ear morphology, awns, gliadins, amylase, grain wt., yield |
| Zea mays | T toxin resistance, male fertility , Mt DNA |
| Lycopersicon esculentum | Leaf morphology, branching habit, fruit colour, pedicel, male fertility, growth |
| Medicago sativa | Multifoliate leaves, elongated petioles, growth branch number plant height, dry matter yield |
| Solanum tuberosum | Tuber shape, maturity date, plant morphology, resistance for early andlate blight, photoperiod, leaf color, vigour, height, skin colour |

.problems with somoclonal variation

* variation is cultivar dependent
* frequencies of change vary
* many changes are undesirable
* some changes are unstable
* many changes are not novel
* characters of interest may not change

methods of assessment of somaclonal variation

* phenotypic parameters(quantitative (leaf size, plant height, qualitative, branching pattern, flowercolour)
* physiological parameters(protein patterns by electrophoresis, secondary products formation)
* genetic parameters (chromosome number and structure, banding pattern)