SCOPE AND POTENTIAL OF TISSUE CULTURE FOR CROP IMPROVEMENT

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A WORKSHOP on the 'Scope and Potential of Tissue Culture for Crop Improvement' was convened from March 5–7, 1986, at the Biotechnology Centre, Indian Agricultural Research Institute, New Delhi. About 25 leading scientists engaged in research on tissue culture and crop improvement through conventional breeding in the groups of cereals (Rice, wheat), oilseeds (groundnut, brassicas) and pulses (gram and arhar), participated in the workshop which was inagurated by Dr N. S. Randhawa, Director General, Indian Council of Agricultural Research. A list of the recommendations of the workshop of such objectives as are achievable in a five year time frame, adopted in a Plenary, Chaired by Dr S. Ramachandran, Secretary, Department of Biotechnology, follows:

I. CEREAL GROUP:

(A) *Rice*:
(i) Production of doubled haploids from anther culture of hybrids.
(ii) Production and evaluation of somaclonal variation especially for traits which can be detected at cellular level, such as tolerance to salinity, other abiotic stresses, and resistance to pathogen toxins.
(iii) Propagation of hybrids and male steriles for heterosis breeding.

(B) *Wheat*:
(i) Standardization of anther culture techniques and the evaluation of doubled haploids.
(ii) *In vitro* mutagenesis of single cells/callus for selection of mutants that can be identified in *in vitro* screening.

(C) *Other recommendations*:
(i) Identification of gene markers and development of linkage groups with the aid of trisomics in rice.
(ii) Basic studies on genome organization of rice for the application of recombinant DNA approaches for the improvement of rice in future.
(iii) Where the state of art is at much higher level in other countries, scientist/s could be deputed for picking up the technology.

II. OILSEED GROUP

(A) *Groundnut*:
(i) Standardization of simple micropropagation methods for increasing copies of F_1 genotypes obtained from infra-specific crosses, and of F_2 genotypes used for measuring parameters requiring destructive sampling. This will facilitate selection of transgressive segregants in F_2 generation.
(ii) Use of somaclonal variation for further improvement of the best adapted cultivars of groundnut.
(iii) Development of embryo rescue technique for developing effective inter-specific hybridization programmes.
(iv) In inter-specific hybridization it would be desirable to cross *Arachis hypogaea* with induced autotetraploid alien species. For this, tissue culture will be needed to maintain induced autotetraploids of the alien species.

(B) *Brassicas*:
(i) Synthesis of *Brassica juncea* by using a wide range of monogenomic species *B. campestris* and *B. nigra*. In this effort tissue culture for rescue of hybrid embryo is necessary. Similar work should be undertaken for synthesis of *B. napus* and *B. carinata*.
(ii) Somaclonal variation should be screened for enlarging genetic variability in *B. juncea*.
(iii) Synthesis of digenomic species – *B. juncea*, *B. napus*, *B. carinata* in a reciprocal fashion.
(iv) Induction of tetraploids in monogenomic species and their maintenance through tissue culture; Crosses among tetraploids to obtain allopolyploids and useful segregants.
(v) Embryo culture techniques should be used for production of sufficient number of hybrids between monogenomic and digenomic species.
(vi) Production of androgenic haploids for obtaining homozygous lines of useful recombinants.
(vii) Mobilization of cytoplasmic male sterility sources through sexual hybridization, embryo rescue or protoplast fusion for hybrid seed production.
(viii) Use of somatic cell hybridization technique for exploiting agronomically useful genes from wide crosses.
(ix) Propagation of *B. campestris* types by somatic embryogenesis for exploiting self-incompatibility mechanisms of these plants for the production of hybrid seed.
(x) Basic work on organelle and nuclear genome organization is necessary for sustained improvement of the Brassicas.

III. PULSE GROUP:

(A) *Chickpea*:
(i) *Interspecific hybridization*: Using distantly related wild annual species endowed with desirable traits, such as disease and pest resistance and tolerance to abiotic stresses, hybridization should be attempted using ovule culture and embryo rescue techniques.
(ii) Standardization of tissue culture techniques should be undertaken to obtain high degree of success in plant regeneration and in transfer of regenerants to soil for further evaluation.
(iii) Selection for salt and frost tolerance.

(B) *Pigeon pea*:

Wide hybridization should be exploited using conventional and *in vitro* techniques involving *Atylosia*, *Rhynchosia* and *Flemingia* species for introgression of desirable genes for characters such as pod borer resistance, cold tolerance, resistance to sterility mosaic virus and *Fusarium* wilt and development of male sterile lines.

IV. SOME IMPORTANT GENERAL RECOMMENDATIONS:

1. *Transfer of tissue culture technology*:
One of the main requirements for transfer of laboratory results in tissue culture to the field is a facility of producing adequate numbers of tissue culture plantlets. No such facility is available at present in the country. Hence it is difficult to produce adequate number of plants for testing in the field and for evaluating the performance of tissue culture plantlets in comparison with conventionally raised ones.

Such a unit will also have several other uses:

(i) Research on improving methods of large scale production is essential and is at present not being carried out on an adequate scale in the country. The optimum requirements for factors like light, sterilization, media etc. requires determination, (ii) the unit can also be used for training personnel for large scale multiplication of principal plant material, (iii) the tissue culture unit should also have ancillary facilities such as green house, mist chamber and experimental fields. When several (10,000–100,000) plants are produced by this unit, they can also be screened for useful variants, mutants, such as dwarfs, male steriles etc.

This unit should have a capacity for producing at least 25,000 to 50,000 plants per year. It should be available for projects which are ready for testing in the country. It need not, in general, be used for more than a short period during the year for producing sufficient material for field tests for any specific species or variety.

2. The identification of problems, assignment of priorities and other aspects of tissue culture programme, if they are to be of practical benefit, requires collaboration of plant breeders, plant geneticists and tissue culture specialists. At present such interactions between these different groups is relatively rare. The present workshop is one of the few which has brought together these specialists. For progress in this field, it would be very useful to have continuous exchange of views between these scientists.

It is proposed that the individual groups such as Brassica group, pulses group (with sub-groups for major legumes) and cereals groups (with sub-groups of rice and wheat) may be formed. These groups will consists of three types of specialists indicated above and may meet at least twice a year for exchange of information, planning and evaluating projects.

3. Basic research in some essential and developing areas should be funded for some of the major crops. These include: (i) development of methods for regeneration from callus and protoplasts of recalcitrant varieties or species of rice, wheat, brassica, legumes and oilseeds, (ii) somatic embryogenesis – since this can drammatically reduce the cost of tissue culture plantlets and greatly facilitate mutation and other programmes, (iii) genome organization of major crops and development of suitable markets for genetic engineering work for chromosomes, for mitochondria and for chloroplasts.

4. *Conservation through non-conventional methods*

Tissue and cell culture also provides an important avenue of genetic conservation and deserves immediate attention to supplement conventional procedures of preserving genetic variability.

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