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AN OVERVIEW ON SOMA CLONAL VARIATION

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ABSTRACT

Plant breeders may use somaclonal variation as a technique. The study looks at the best places to use this technology and the variables that restrict or enhance its chances of success. (1) the degree of deviation from ordered development, (2) the genotype, (3) growth regulators, and (4) the tissue supply are the major variables that affect the variety produced by tissue culture. Despite growing knowledge of how these variables interact, it remains impossible to anticipate the result of a somaclonal breeding effort. Somaclonal variation has resulted in the creation of new varieties, but in many cases, better variants were not chosen because (1) the variance was all negative, (2) significant improvements were also greatly changed in negative ways, (3) the modifications were not novel, or (4) the modifications were not steady after selfing or crossing. Somaclonal variation is less expensive than other genetic modification techniques. It is also more generally applicable at the moment and does not require confinement measures. It's worked best in crops with restricted genetic systems or genetic bases, where it may offer a quick source of variety for crop development.

KEYWORDS: *Genetic, Soma clonal variation, Tissue culture.*

INTRODUCTION

Tissue culture is an enabling technique that has spawned a slew of new tools to aid plant breeders. These technologies may be used to enhance the speed or efficiency of the breeding process, expand the accessibility of existing germplasm, and generate novel crop variety. Micro-propagation, embryo rescue, another culture, in vitro selection, somaclonal variation, somatic hybridization, and transformation are some of the techniques used. Somaclonal variation has a special place among them since it is both a benefit and a drawback of tissue culture methods. It was not anticipated that the asexual culture process would result in variety. The uncontrolled

generation of non-'true-to-type' plants continues to be a concern in almost all other applications of plant tissue culture. Larkin and Scowcroft, who examined the topic in 1981 and were among many writers at the time to call attention to its potential applications for crop development, were the first to characterize soma clonal variation as such. Their predictions were mainly based on reports of widespread diversity in plants produced from potato protoplast or explant cultures. Soon after, a slew of reports appeared in a variety of species, indicating that somaclonal variation was ubiquitous and therefore presumably available to all plant breeders[1]. Since then, many genuine efforts to enhance crops via somaclonal variation have been undertaken, and although many have failed, there have been noteworthy triumphs (see below). As a result, our starting point is that somaclonal variation is a tool that plant breeders may utilize. The questions that will be answered here are about where this tool can be used most effectively and what variables restrict or enhance the instrument's ability to be used successfully[2]. This evaluation will be limited to the direct application of somaclonal variation for plant breeding due to a lack of space. The application of somaclonal variation for hybrid introgression and then in vitro selection of plants with better stress tolerances, such as temperature, is discussed elsewhere in the proceedings.

As a tool, how dependable is somaclonal variation?

The issue of somaclonal variation's reliability as a breeding technique may be divided into three parts: (a) Is there always variety in in vitro culture? (b) Is it always possible to restore useful variation? (c) Is somaclonal diversity in all crop species beneficial? Is there always variety in in vitro culture? It is impossible to say that in vitro cultivation will always result in variety. In reality, there are a lot of variables that affect whether or not variation is created, as well as how much variation is generated. (1) the degree of deviance from organized meristematic development, (2) the genetic makeup of the starting material, (3) the growth regulators in the medium, and (4) the tissue source are all variables to consider.

The degree to which growth is deviated from meristematic organized growth. In culture, growth may come from pre-existing meristems or from a disorganized form called a callus, from which organized structures emerge through somatic embryogenesis and organogenesis. Disorganization of development is a major component of somaclonal variation, implying that the restrictions that work to remove genetic variants in normal meristems are repressed or that processes of genetic instability are activated in disorganized growth. In general, the larger the deviation from organized growth and the longer the period spent in this condition, the higher the likelihood of somaclonal variation. It is more acceptable to use this criterion rather than making broad generalizations about the degree to which various tissue culture methods are linked to somaclonal variation. This is due to the fact that the amount of time spent in a disorganized state varies greatly from system to system and even from species to species. Cell suspension cultures, for example, are thought to be genetically unstable, whereas protoplast culture is linked to large levels of somaclonal variation. Nonetheless, since the cultures are extremely stable, spruce (Picea mariana) seedlings regenerated from protoplasts of embryogenic cell lines are expected to be devoid of somaclonal variation. Protoplasts produced from these embryogenic cultures may directly create embryos[3].The individual's genetic makeup There is a growing body of data that suggests somaclonal variance is genotype-dependent. In reality, it may be difficult to distinguish genotype effects from variations in tissue culture response since the latter is also genetically

controlled, although a number of studies have shown that genotype can affect somaclonal variation regardless of regeneration method. The genotypic element's precise nature must be determined since plant breeders will want to utilize somaclonal variation as a tool in particular lines or cultivars and will want to know if their genotypes will respond to variability. Unfortunately, this is not a simple issue to address, since genotypic differences are caused by a variety of variables, which interact in complicated ways.

The cultural setting?

There's a lot of evidence that the medium you choose, and especially the concentration of growth regulators in it, has an impact on somaclonal variance. It's conceivable that growth regulators have mutagenic properties. 2,4-D, a synthetic auxin, has been found to enhance the frequency of blue to pink mutations in the Tradescantia stamen hair system and to cause substantial increases in the frequency of sister chromatid exchanges in Allium sativum root-tip cells. However, there are few instances of this kind, and the majority of data suggests that growth regulators influence somaclonal variation during the culture phase by affecting (1) cell division, (2) the degree of disorganized development, and (3) the selective proliferation of particular cell types.

Source of tissue

When regeneration is accomplished from various tissue sources, there may be differences in the frequency and type of somaclonal variation. In general, the older and/or more specialized the tissue, the better the odds of recovering diversity in the regenerated plants. Gross alterations in the genome, such as endopolyploidy, polyteny, and amplification or diminution of DNA sequences, often follow somatic differentiation in normal plant growth and development, resulting in these consequences. This issue is further confounded by genotype, since there seem to be two classes of plants depending on the amount of genomic diversity present in the soma (polysomatic or non-polysomatic plants, respectively). Differentiated cells in non-polysomatic plants are kept in the same ploidy state as the zygote, while differentiated cells in polysomatic plants may have polyploid, polytene, or even aneuploid constitutions. The impact of tissue source would be greatest in polysomatic species, however although there are certain plants that fit into this category, it is not always obvious which kind of plant is being utilized. In Solanum brevidens, 70 percent of plants regenerated from cotyledons were tetraploid, while only 20% of plants regenerated from leaf fragments were tetraploid. Plants grown from cultured petals were more floriferous and had a greater frequency of abnormalities than plants grown from pedicels in Chrysanthemum. Plants regenerated from stems did not vary from controls in fragrant Pelargonium, while regenerants from root and petiole parts had a wide range of shape[4].

It always possible to restore useful variation:

In almost every instance where comprehensive field experiments on somaclones have been conducted, there has been strong evidence that in vitro cultivation has caused alterations in agronomic characteristics. However, better variations have not been chosen for breeding purposes in the majority of instances, due to one or more of the following factors: The shift was in the wrong direction. For example, in a three-year field evaluation of seed progenies of tissue culture-derived spring wheat plants, researchers found that nearly all of the regenerated lines yielded less than the controls, concluding that the tissue culture process had produced "an array

of agronomically inferior genotypes." Similarly, a field assessment of barley somaclones revealed that the little variation found was entirely negative in value[5].

When it comes to good improvements:

Other parts of the plants were also impacted. Higher grain protein levels in the seed progenies of regenerates were linked to poorer yields in the spring wheat field study mentioned above. Similarly, several of the potato plants reported as having increased disease resistance by Shepard and colleagues were subsequently shown to be aneuploidy.Not all of the modifications made were new.Variations in the inflorescence were among the most frequent types of alteration in a study of somaclonal variation generated in seven cultivars of plantains (Musa spp.). Reversion to a normal French plantain bunch form of inflorescence occurred at a frequency of 2.7% in the False Horn plantain 'Agbagba'. However, such 'French reversion' has been observed in conventional propagules as well, albeit at a considerably lower frequency (0 .7 percent)

Is somaclonal variation as effective in all crops as it is in some?

It is true that somaclonal variation has resulted in the development of new varieties of Paulownia tomentosa tomatoor celery, sugar cane,. It should also be noted that, despite so many intensive efforts, the technique has proven completely ineffective in many other crops, including wheat, maize, as well as barley. It may be able to predict which crops somaclonal variations is more likely to work as a crop enhancement technique by looking at some of the successful instances[6].

Stress and genetics have an impact.

Somaclonal variation may be induced by stress during tissue culture. Various genomes, on the other hand, react in different ways.stress-induced variation, implying that somaclonalThere are genotypic components to variance. The distinctions inDifferences in genetic make-up are linked to stability.where certain elements of the plant DNA cause them to growDuring the cultural process, the environment becomes unstable. This may be a better option.Repeated DNA sequences may be explained by the repetitive DNA sequences, which canPlant species vary in quality and quantity (Lee).Phillips (1988) and others).A cultivar's inherent fragility was a significant issue.impacted the development of dwarf off-type banana tissueculture. The cv. ‘New Guinea Cavendish', for example, possessed aIn vitro, cv. ‘Williams' has a greater degree of instability.In the same way, dwarf off-types remained stable in vitro.tissue culture, as well as the tissue culture conditions that resulted inadvantages and disadvantages of somaclonal variation compared to other tools.

Many writers have argued that selecting for incremental improvements in existing varieties by running the best available lines through a tissue culture cycle is an obvious approach for using somaclonal variation in breeding. However, it will not be regarded an economically feasible technique until variations of a specific type can be produced more easily via somaclonal variation than from other approaches. One of the most significant drawbacks of somaclonal variation, which makes it relatively difficult to use, is that, despite the discovery of variables influencing a plant species' variation response, it is still impossible to anticipate the result of a somaclonal program. In reality, for many crop species where general molecular genetic information is inadequate, small scale pilot experiments are the only method to determine if a broad range of somaclonal variation will be produced under a given set of culture conditions.

Even yet, there is no assurance that a particular characteristic of interest will be positively changed. Other significant issues include the huge number of inferior lines produced and the fact that some of the modifications are not stable. In contrast to these drawbacks, somaclonal variation has a number of benefits. It is a less expensive type of biotechnology than somatic hybridisation and transformation, and it does not require any 'containment' processes. There are more plant species accessible in tissue culture systems than can be handled through somatic hybridisation and transformation at this moment. It is not required to have discovered the trait's genetic origin, or even to have isolated and cloned it in the case of transformation. Novel variations have been discovered among somaclones, but genetic cytogenetic data suggests that transit through tissue culture may change the frequency or distribution of genetic recombination events. This indicates that variation may come from places other than the regions of the genome that are accessible to conventional as well as mutant breeding[7].

Advantage

The benefits include:

- It is less expensive than other genetic modification techniques and does not need ‘containment' processes.
- There are more plant species accessible in tissue culture systems than can be handled through somatic hybridization and transformation at this time.
- It is not required to have discovered the trait's genetic origin, or even to have isolated and cloned it in the case of transformation.
- Novel variations have been discovered among somaclones, and evidence suggests that transit through tissue culture may change the frequency and distribution of genetic recombination events. This means that variation may come from places in the genome other than those that are accessible to conventional and mutant breeding.
- If somaclones are produced via cell culture, there is no way to get chimeric expression Crops with restricted genetic systems (e.g., apomicts, vegetative reproducers) and/or narrow genetic bases have had the greatest success with somaclonal diversity. In the case of ornamental plants, for example, the use of in vitro-generated diversity has become standard practice in many commercial breeding operations.

Disadvantages

One of the major drawbacks of somaclonal variation that makes it relatively difficult to utilize is that, despite the discovery of variables influencing a particular plant species' variation response, the result of a somaclonal program cannot be predicted since it is random and unreliable. Furthermore, since many genetic alterations are caused by point mutations or chromosomal rearrangements, the majority of R1 segregates. As a result, selecting individuals with gains in the R1 generation for quantitative characteristics like yield is almost difficult. Though many horticultural crops have developed ways for selecting somaclones resistant to different biotic and abiotic stressors, there are currently no in vitro selection methods for complex characteristics like as yield, soluble solids, sweetness, texture, or shelf life.

LITERATURE REVIEW

Michael W. Bairu et al.studied about the plant tissue culture has become one of the most important techniques in plant science research. It's widely used in the cultivation, conservation, and enhancement of plant resources. The existence of somaclonal variation in populations generated from tissue culture has had a detrimental impact on tissue culture's usage and continues to be a significant concern. It is, on the other hand, a source of new desirable clones/variants with improved agronomic characteristics. We describe the potential causes, detection techniques, and desirability of variations in this review. One of the most studied and discussed subjects is somaclonal variation. As a result, we limited ourselves to presenting a few instances that might serve as useful references for researchers looking to discover and/or describe somaclonal variations while conducting research and manufacturing utilizing tissue culture. The detrimental consequences of somaclonal variation are highlighted. This study does, however, contain instances of certain beneficial variations that arise from somaclonal variation[8].

M. Karppler et al. studied about the Somaclonal variation is expressed as cytological defects, frequent qualitative & quantitative phenotypic mutation, sequence alteration, and gene activation and silencing, activation of dormant transposable elements and retrotransposons suggests that epigenetic alterations occur during culture. Epigenetic activation of DNA elements also indicates that epigenetic alterations may be implicated in cytogenetic instability through heterochromatin modification, as well as phenotypic variance via gene function regulation. The fact that DNA methylation patterns are extremely varied across regenerated plants and their offspring suggests that DNA changes in culture are less permanent than in seed-grown plants. The relative significance of epigenetic vs sequence or chromosomal variation in regulating somaclonal variation in plants will be determined in future study[9].

Somaclonal variation, as defined by G. C. Mgbeze et al, refers to any phenotypic or genotypic changes that occur as a result of in vitro cultivation. Fruit mantling and irregular vegetative development are common symptoms in oil palms. Tissue culture is still the only way to micropropagate oil palms since their biological features prevent traditional vegetative propagation. The early success of plantlet generation prompted several oil palm groups to investigate the method of in vitro propagation. Despite the fact that oil palm tissue culture is highly established, it nevertheless faces many difficulties. Somaclonal variation, which was originally discovered in 1986, is one of the most prominent. They can only be detected after the palms begin to bloom, which occurs after two to three years in the field. Floral irregularity in the oil palm has not been completely eliminated or avoided. Several methods, such as lowering hormone levels, preventing fast-growing calluses, and shortening the culture time, have decreased the issue to tolerable levels of 5%. The reasons behind somaclonal variation in the oil palm are addressed, as well as the variables that influence it[10].

DISCUSSION

Tissue culture is an enabling method that has resulted in the development of a plethora of new tools to assist plant breeders. These technologies may be used to speed up or improve the breeding process, make current germplasm more accessible, and create new crop varieties. Some of the methods utilized include micropropagation, embryo rescue, another culture, in vitro selection, somaclonal variation, somatic hybridization, and transformation. Because it is both an

advantage or drawback of tissue culture techniques, somaclonal variation has a unique position among them.Any phenotypic or genotypic changes that occur as a result of in vitro culture are referred to as Soma clonal variation. Fruit mantling and irregular vegetative development are common symptoms in oil palms. Tissue culture is still the only way to micro propagate oil palms since their biological features prevent traditional vegetative propagation. After selfing or crossing, the changes were not consistent. Other genetic alteration methods are more costly than Soma clonal variation. It is also more widely applicable at the present and does not need the use of restraints. It has been most successful in crops with limited genetic systems or genetic bases, where it may provide a fast source of diversity for crop growth. In crops with restricted genetic systems and/or narrow genetic bases, it is most likely to be regarded a viable technique.

CONCLUSION

Tissue culture is an enabling method that has resulted in the development of a plethora of new tools to assist plant breeders. These technologies may be used to speed up or improve the breeding process, make current germplasm more accessible, and create new crop varieties. Based on these debates, the only conclusion that can be drawn at this time is that, although soma clonal variation is a tool that breeders may employ, it is not a precise instrument and can only be controlled to a limited extent. Despite this, it may provide a quick and easy source of variety for use in breeding programs. In crops with restricted genetic systems and/or narrow genetic bases, it is most likely to be regarded a viable technique.

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