Article **ECORFAN Journal-Republic of Nicaragua**
December 2023, Vol.9 No.17 15-20

Technoscience in cloning *Drosera spatulata* from leaf explants, its dissemination through social marketing

Tecnociencia en clonación de *Drosera spatulata* a partir de explantes de hoja, su divulgación mediante mercadotecnia social

ESPEJO-MARTÍNEZ, Abraham†* & ESPEJO-CRUZ, Abigail del Carmen

Universidad Autónoma "Benito Juárez" de Oaxaca, Oaxaca, México, Universidad Politécnica de Valencia, Valencia, España

ID 1st Author: *Abraham, Espejo-Martínez* / **ORC ID:** 0000-0001-9888-4892, **Researcher ID Thomson:** F-9497-2019, **arXiv ID Author:** aem1 - PubMed aem1, **CVU CONAHCYT ID:** 478023

ID 1st Co-author: *Abigail del Carmen, Espejo-Cruz* / **ORC ID:** 0000-00018832-0428, **Researcher ID Thomson:** GVT-1252-2022, **arXiv Author ID:** adespcru, **PubMed ID author:** abigailespejo1, **CVU CONAHCYT ID:** 1160132

DOI: 10.35429/EJRN.2023.17.9.15.20 Received July 30, 2023; Accepted December 30, 2023

Abstract

In 1996, humanity learned of such a transcendent and new result in the world of biology through the dissemination of the cloning of a living being, the birth of Dolly the sheep in the United Kingdom, from that moment on science and technology came together more closely to investigate the possibilities of being able, through genetic manipulation, to duplicate living beings based on an already existing one. In the world of plants, something similar has happened and the present work gives an account of it by developing viable in vitro culture techniques for the cloning of species of ornamental plants where for this specific case *Drosera spatulata* was taken or in common terms carnivorous plant, taking into account the possibility of regenerating plant material and obtaining complete developed plants, free of pathogens and under controlled conditions whose results serve as a basis for future research through its dissemination through social marketing.

Plant cloning, *In vitro* cultivation, Social marketing

Resumen

En el año 1996 la humanidad se enteró de un resultado tan trascendente y nuevo dentro del mundo de la biología mediante la divulgación de la clonación de un ser vivo, el nacimiento de la oveja Dolly en el Reino Unido, a partir de ese momento la ciencia y la tecnología se unieron mas estrechamente para indagar las posibilidades de poder, a través de la manipulación genética, duplicar seres vivos con base en uno ya existente. En el mundo de las plantas ha ocurrido algo semejante y el presente trabajo da cuenta de ello al desarrollar técnicas de cultivo in vitro viables a la clonación de especies de plantas ornamentales en donde para este caso específico se tomó a la Drosera spatulata o en términos comúnes planta carnívora, teniendo en cuenta la posibilidad de regenerar material vegetal y obtener plantas desarrolladas completas, libres de patógenos y en condiciones controladas cuyo resultado sirva de base para futuras investigaciones mediante su divulgación a través de la mercadotecnia social.

Clonación vegetal, Cultivo *in vitro*, Mercadotecnia social

Citation: ESPEJO-MARTÍNEZ, Abraham & ESPEJO-CRUZ, Abigail del Carmen. Technoscience in cloning *Drosera spatulata* from leaf explants, its dissemination through social marketing. ECORFAN Journal-Republic of Nicaragua. 2023. 9-17:15-20.

* Correspondence to Author (E-mail: aem@usa.com)
† Researcher contributing first author.

Introduction

The concept of technoscience defines not only the process of articulation between contemporary science and technology as an innovative expression of research, but also refers to the material and intellectual production that assumes the communion between science and technology in the new research tasks and dynamics that not only explain reality but also intervene in it and the conceptions that are determined about reality given the uses in specific social contexts where cultural, symbolic, ideological, economic and aesthetic dimensions, among others, are configured (Osorio, 2022).

Since the first record in 1908 biotechnology [...] has had important advances such as cloning (Ugalde, et. al. 2020). The socio-technical context has led to an evolution in the possibilities of experimentation on living things, transcending the laboratory and establishing previously unknown interdisciplinary working methods (Sturbin, 2021). Since the birth of the world's first mammal cloned from adult cells (Dolly the sheep in 1996), the technique has been constantly improved (Bilañski, 2020).

Today, the basis of plant breeding is based on creating genetic variation, selection, evaluation, identification and cloning of new genotypes (Tiessen, 2012). According to Vázquez et al. (1997), clonal or vegetative propagation of plants is a production from vegetative parts where plant tissues that retain the potential for cell multiplication and differentiation are used to generate new stems and roots from cell clusters present in various organs. There are essentially three variants of this type of propagation:

- Micropropagation from plant tissues in in vitro culture.
- Propagation from bulbs, rhizomes, stolons, tubers or segments (cuttings) of plants with rooting potential.
- Propagation by grafting plant segments onto the stems of more resistant receptive plants.

Vegetative propagation ranges from simple procedures, known from time immemorial to farmers all over the world, to technologically advanced procedures, based on plant tissue culture technology, by which the mass propagation of genetically homogeneous, improved and pest-free plants can be achieved. Modern procedures allow the production of cultivars totally free of pathogens, including viruses, and even the manufacture of artificial seeds by means of somatic embryogenesis and encapsulation. In addition to propagation, in vitro tissue culture techniques also allow modern germplasm conservation procedures to be followed thanks to the prolonged maintenance of slow-growing cultures and cryopreservation of tissues.

Cloning of individuals

Reproduction through in vitro meristem culture, or cloning, is very efficient and consists of removing a root tip or shoot tip and placing it in a suitable culture medium under sterile conditions. Under the influence of phytohormones, the meristems develop into a mass of undifferentiated tissue, capable of giving rise to new seedlings. The seedlings thus obtained are separated from each other and grown in separate test tubes. The plants are perfect clones of the original plant, so this is the method most applicable to mass propagation of a particular variety or of sterile hybrids.

Genus Drosera

Represents the largest genus of carnivorous plants with approximately 195 species. It is named after the Greek drosos, meaning dew or dewdrops. Members of this genus are easily identified by the fact that they attract, capture and metabolise insects and some protozoa by means of glands. In spite of the above, their reality is not affected in the absence of insects, but their growth is not.

Characteristics

They are mostly herbaceous perennials, although some may be annuals. Their size depends on the available nutrients and can vary from one centimetre to one metre. It has been proven that these plants can live up to 50 years.

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Because this genus has evolved depending on the presence of insects, it currently lacks enzymes that promote nitrate reductase activity, i.e. it is poorly able to metabolise the nitrogen present in the soil.

Taxonomy

Reino: *Plantae*

Division: Magnoliophyta

Class: Rosopsida

Order: Caryophyllales

Family: Droseraceae

Genus: *Drosera*

Uses

As a medicinal plant: Many medicinally active compounds are found in sun dews, including flavonoids, quinones, and other compounds, among which plant acids (citric acid, formic acid, gallic acid), resin, tannin and vitamin C are prominent.

Today these plants are used for their constituents in between 200 and 300 registered medicines, usually in combination with other active ingredients. Drosera is currently used to combat ailments such as asthma, coughs, lung infections and stomach ulcers.

Medicines are mainly made using the roots, flowers and fruits of the plant. Since most of the species of this genus are protected in many parts of Europe and North America, extracts are prepared by cultivating fast-growing sun sprays or imported from Madagascar, Spain, France, Finland or the Baltic countries. Some species are used as a homeopathic remedy to treat spasmodic coughs and other respiratory conditions, as well as being a remedy for paranoid states.

As an ornamental plant: Due to their carnivorous nature and the beauty of their mucilaginous traps, sun dewclaws have become very popular ornamental plants. However, the environmental requirements of most species are relatively restricted and they can be difficult to grow, so many do not fulfil this role.

A few species have made inroads into the market and can be seen for sale, where they are frequently found *D. capensis*, *D. aliciae* y *D. spatulata*.

The requirements for cultivation vary greatly between species. In general, they need a very humid environment, in the form of constant moisture or a soil with soil that meets these characteristics. Many species also require pure water, as nutrients, salts or minerals in their substrate can limit their growth or even kill them. Plants are commonly grown in substrates accompanied by moss. *Sphagnum* (dead or alive) or sand, and can be irrigated with distilled water, reverse osmosis or rainwater.

Other uses: Some species are used in the textile industry as dyes in that region, while yellow and violet dyes are prepared in Scotland by using *D. rotunidfolia.* A sun dew liqueur is still made, the recipe for which has its roots in the 14th century, using fresh leaves of *D. capensis*, *D. spatulata* y *D. rotundifolia*.

Marketing is defined as those activities aimed at satisfying individual and organisational needs, beliefs and desires, which are classified in two dimensions: commercial marketing, which focuses solely on obtaining economic interests without promoting changes in the population, selling its services through ideas; and social marketing, whose main interest is to improve the needs of the market without economic purposes, in order to achieve changes in the behaviour and attitudes of the population (Priego, 2015), in such a way that an application can be found to the knowledge that is generated and reach society, having a better dimension of the existing unmet needs (Verre, Milesi & Petelski, 2020), taking into account the ease it represents when used as a tool to disseminate knowledge and research results making this information available to the society interested in them.

Methodology to be developed

For this experiment, eight adult individuals were taken as specimens of *Drosera spatulata in vitro*. Subsequently, inside a switched on laminar flow cabinet and with sterile tools, the material was extracted from the culture medium and placed on sterile paper, where the plant leaves were later cut.

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Then, in five flasks with culture medium previously prepared with one-third concentration of its elements, the explants were placed with the help of sterile forceps, making sure that the underside of the leaves touched the culture medium. Eight explants per flask were placed in the culture chamber at a controlled temperature of 24°C. The flask was closed with the lid and placed in the culture chamber.

To determine whether the cloning was successful or not, the material was kept under continuous observation, waiting for disorganised growth callus, which may or may not allow the development of apices, which will be counted to record the number of seedlings obtained.

Results

The results described below were reported up to 29 July, depending on the starting date of each experiment, the days that elapsed from day 1 are mentioned.

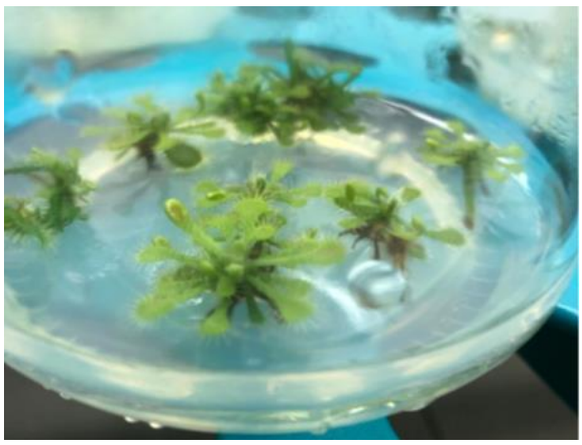

Figure 1 Results of cloning of Drosera spatulate
Source: Own elaboration

The experiment was started on 19 June and lasted 50 days

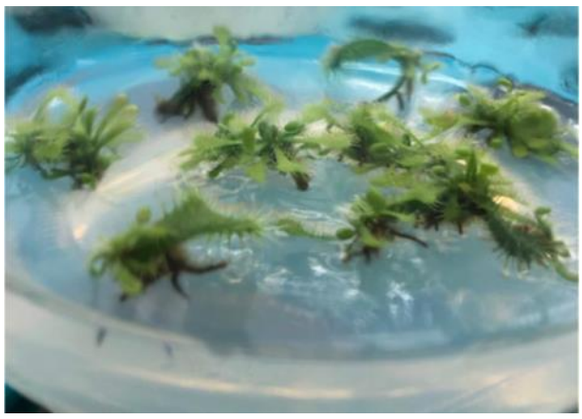

Figure 2 View of seedlings obtained from the cloning of Drosera spatulate
own elaboration.

As a result, 50 initial leaf explants were obtained, from which a total of 200 seedlings were obtained at a sufficient aerial and root development stage for cloning in their own container.

Figure 3 View of the root system of the plants obtained from the cloning of *Drosera* spatulate
Source: Own elaboration

Concluding remarks

Reproduction: Many species of this genus are self-fertile and the flowers self-pollinate before closing. Vegetative reproduction occurs naturally in some species that produce stolons or when the roots approach the soil surface. Stale leaves touching the substrate may also germinate seedlings.

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Pygmy sun dewroses reproduce asexually using special leaves called gems, which can be propagated by cutting their leaves, their roots or by planting their seeds.

They can produce seeds that require different specific conditions to germinate, which are mainly determined by the climate and the structure of the plant itself. It is very common for this genus to produce stolons when the roots come close to the ground, thus generating new seedlings. They also produce gems from their leaves, so propagation is easy.

Habitat

Plants within the genus grow during the wet season or constantly in habitats with acid-rich soils and high levels of sunlight. Common habitats include bogs, swamps, marshes and wet banks. Many species grow in association with mosses that absorb much of the nutrients from the substrate and acidify it, making them less accessible to the plant.

It is a highly variable genus in terms of habitat. Some have adapted to a wide variety of environments, including rainforests, deserts and even shady environments. The temperate species, which form a hibernaculum in winter, are an example of this kind of adaptation to their habitat; in general, these plants are more abundant in warm climates and have moderate cold hardiness.

Conclusions

The application of technoscience makes it possible to communicate and disseminate the scientific and technological aspects inherent to it in such a way that they are available to all sectors of society as a new form of knowledge.

Nowadays, there are tools, knowledge and strategies that allow us to carry out the necessary experiments for the reproduction of plants as alternative measures for their conservation and propagation in such a way that species in danger of extinction due to lack of care in their habitat or overexploitation can be rescued.

Social marketing through its strategies, techniques and studies contributes to disseminate ideas that benefit society by promoting a more responsible behaviour and at the same time generating positive impacts through its implementation in different fields of knowledge dissemination.

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