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OPTIMIZATION OF COTTON INTRODUCTION INTO *IN VITRO* CULTURE AND PROSPECTS OF THE METHOD FOR THE DEVELOPMENT OF COTTON PRODUCTION IN UKRAINE

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Cotton (*Gossypium spp*.) is an annual plant belonging to the family Malvaceae. Its life cycle ranges from 110 to 180 days depending on the cultivar. The height of a mature plant typically varies from 1 to 2 meters. Cotton also serves as a raw material for the production of medical dressings and personal hygiene products, cellulose and paper, plastics and films, varnishes and paints, explosives, pharmaceutical excipients, and more. Cotton fiber is the most widely used natural textile material in the world. In addition, cotton is an important oilseed crop. Cottonseed oil is suitable for both technical applications and consumption by humans and animals. In regions where cotton is a dominant crop, the share of cottonseed oil in the market may reach up to 70%. Cottonseed meal is rich in protein and is widely used as a component of livestock feed [4].

The southern region of Ukraine is suitable for cotton cultivation. The cultivation of cotton under the conditions of the southern steppe of Ukraine has a history of more than a century. The current stage of development of the national agro-industrial sector is characterized by the search for new niche and strategic crops. Numerous scientific studies, field trials, and practical experience confirm the high potential of cotton as a promising crop for the southern regions of Ukraine. Despite general climate warming, the climatic conditions of Ukraine remain relatively harsh for cotton cultivation, particularly due to the risk of spring frosts and insufficient accumulation of active temperatures in certain years. This necessitates the development of locally adapted

cultivars suited to specific soil and climatic zones, with high productivity and superior fiber quality. Key traits for cotton breeding under the conditions of the southern Ukrainian steppe include early maturity, drought tolerance, fiber length, and boll weight. To date, specialists of the Institute of Irrigated Agriculture of the National Academy of Agrarian Sciences of Ukraine have developed two early-maturing, medium-fiber cotton cultivars, *Pidozerskyi-4* and *Dniprovskiy-5* [1]. Continued efforts to improve existing cultivars and develop new ones remain highly relevant for Ukraine.

In vitro culture methods represent a high-tech tool in plant breeding. Their application facilitates overcoming reproductive barriers, accelerates the propagation of promising genotypes, and ensures the conservation of valuable genetic material. Furthermore, the use of somaclonal variation and cell selection on selective media enables the identification of forms with desirable traits, such as resistance to biotic and abiotic stresses. Plant tissue culture is also an essential platform for targeted genetic transformation [3].

Due to the possibility of conducting continuous research throughout the year, in vitro technologies are becoming a key factor in accelerating cotton breeding. This opens new opportunities for the rapid development of high-yielding cultivars capable of fully realizing their potential under the arid conditions of southern Ukraine.

It is well known that one of the most critical stages in plant biotechnology is the establishment of explants in in vitro culture. At this stage, maintaining sterility and optimizing the composition of the nutrient medium are essential. To prevent contamination in in vitro culture, careful sterilization of explants, equipment, and culture media is required [2].

The aim of this study was to evaluate the feasibility of cotton cultivation in vitro and to determine optimal conditions for obtaining sterile regenerated plants from seed material.

Seed material of the cotton cultivar ‘Chirpan 539’ was kindly provided by the staff of the Plant Breeding and Genetics Institute – National Center of Seed and Cultivar Investigation (Odesa).

As a result of the study, an optimized stepwise sterilization protocol for cotton seeds was developed for their introduction into in vitro culture.

The sterilization procedure included the following steps:

1. Preliminary washing in a soap solution for 10 minutes;
2. Rinsing with distilled water;
3. Sterilization with 15–20% sodium hypochlorite solution for 15 minutes;
4. Rinsing with sterile distilled water;
5. Treatment with 96% ethanol for 1 minute, followed by rinsing with sterile water.

Sterilized seeds were transferred onto sterile paper filters in Petri dishes to initiate germination and root system development. After germination, the material was introduced into in vitro culture on hormone-free Murashige and Skoog (MS) medium for further growth and development. The cultures were maintained at +20–25°C under a 12-hour photoperiod (12 h light / 12 h dark).

During the first week of cultivation, the proportion of germinated aseptic seeds reached 40%. In the second week, an intensification of growth processes was observed, resulting in a germination rate of 70%. The final yield of viable cotton plants under in vitro conditions was approximately 60%.

The obtained collection of aseptic cotton plants is being maintained and serves as a source of primary explants from various vegetative organs. This provides a necessary basis for the initiation of callus formation, further biomass proliferation, and advanced studies within the framework of cell selection programs.

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ТЕХНОЛОГІЯ БІОСИНТЕЗУ БІОФУНГІЦИДІВ НА ОСНОВІ *TRICHODERMA*

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Біофунгіциди на основі грибів роду *Trichoderma* є перспективною альтернативою хімічним засобам захисту рослин завдяки високій антагоністичній активності проти фітопатогенів, екологічній безпечності та здатності стимулювати ріст рослин. Найбільш поширеними продуцентами біофунгіцидів є *Trichoderma harzianum*, *T. viride*, *T. asperellum* та *T. virens* [1]. Механізм їх дії ґрунтується на мікопаразитизмі, конкуренції за субстрат, синтезі антибіотичних речовин, а також продукуванні гідролітичних ферментів — хітиназ, целюлаз і β-1,3-глюканаз, які руйнують клітинні стінки патогенних грибів [2].

Технологія біосинтезу біофунгіцидів включає декілька основних етапів: селекцію активного штаму, підготовку поживного середовища, культивування, ферментацію, стабілізацію та формуляцію готового препарату. На першому етапі здійснюють виділення високопродуктивних штамів *Trichoderma* з ґрунту або рослинних решток із подальшим тестуванням їх антагоністичної активності щодо фітопатогенів. Важливими критеріями відбору є швидкість росту міцелію, інтенсивність спороутворення та стійкість до змін температури й вологості [3].

Для культивування грибів використовують рідкі та тверді поживні середовища, що містять джерела вуглецю та азоту. Найчастіше застосовують мелясово-соєве, картопляно-глюкозне або зернове середовище. Оптимальні параметри ферментації становлять температуру 25–28 °C, pH 5,5–7,0 та активну аерацію середовища [4]. У промислових умовах застосовують глибинне