
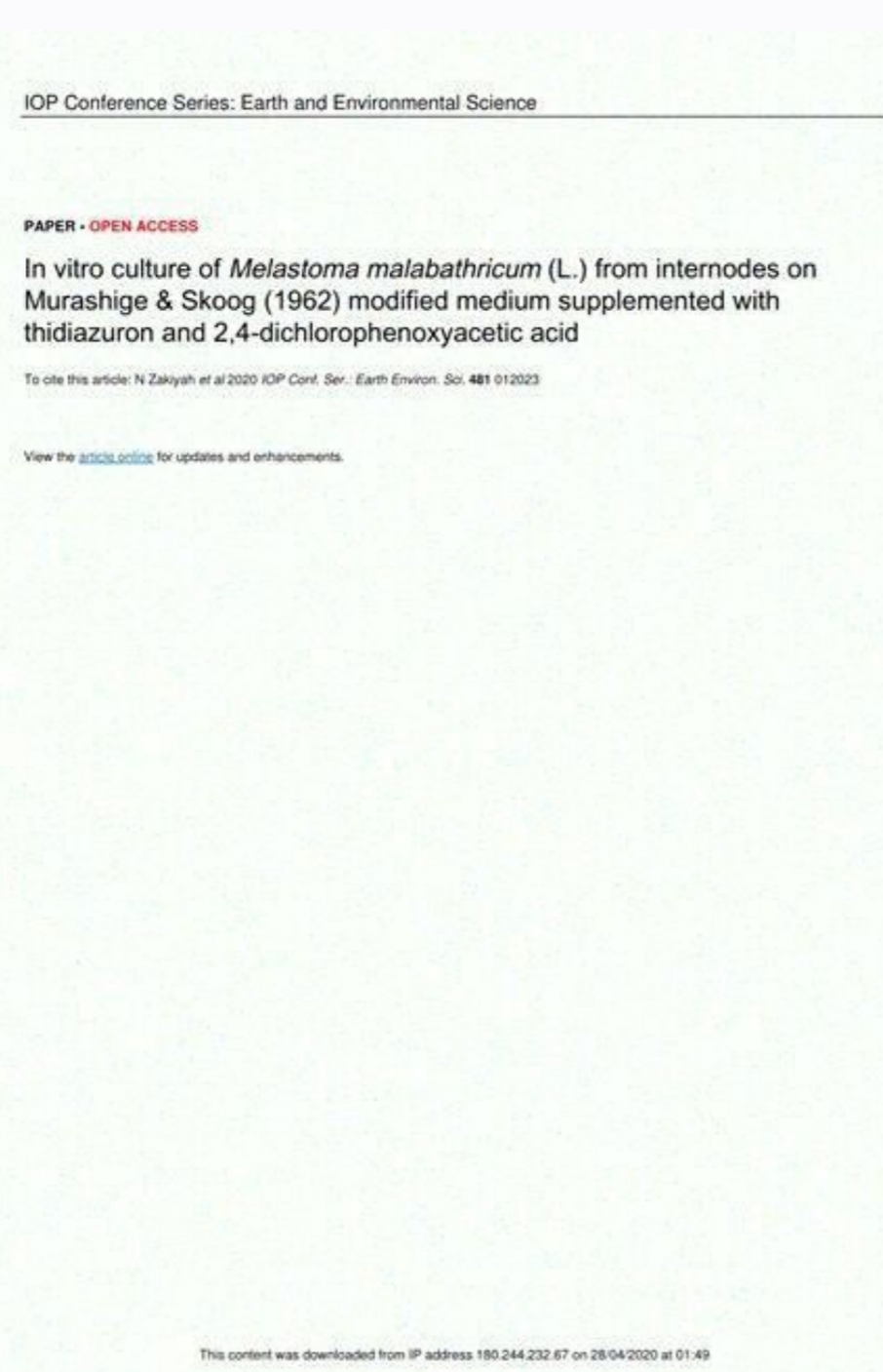


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MS1 for plant tissue culture is suitable for growing callus and different plant organs. Composition mg/L: NH_4NO_3 1650, KNO_3 1900, $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ 440, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ 370, KH_2PO_4 170, KI 0.83, H_3BO_3 6.2, $\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ 22.3, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ 8.6, $\text{Na}_2\text{MoO}_4 \cdot 2\text{H}_2\text{O}$ 0.25, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ 0.02, $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ 0.025, Ferric-EDTA 43, sucrose 3%, pH 5.7, inositol 100, nicotinic acid 0.5, pyridoxine $\cdot \text{HCl}$ 0.5, thiamine $\cdot \text{HCl}$ 0.4, indoleacetic acid (IAA) 1 - 30, and kinetin 0.04 - 10. Microelements, vitamins, and hormones may be prepared in a stock solution and added before use. For kinetin, other cytokinins may be substituted such as 6-benzylamino purine (BAP) or isopentenyl adenine (or its nucleoside), for IAA, naphthalene acetic acid (NAA), or 2,4-D (dichlorophenoxy acetic acid) may be substituted or a combination of the hormones may be used in concentrations that are best suited for the plant and the purpose of the culture. For solid media, use agar or gellan gum. Heat labile components are sterilized by filtering through 0.45 μm . Growth medium used in plant cell culture Mammillaria sp. on MS media in agar Murashige and Skoog medium (or MSO or MS0 (MS-zero)) is a plant growth medium used in the laboratories for cultivation of plant cell culture. MS0 was invented by plant scientists Toshio Murashige and Folke K. Skoog in 1962 during Murashige's search for a new plant growth regulator. A number behind the letters MS is used to indicate the sucrose concentration of the medium. For example, MS0 contains no sucrose and MS20 contains 20 g/L sucrose. 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BraunBiologyProceedings of the National Academy of Sciences...1958This topic is particularly fitting that this topic should be on a program where the hosts are the New York Botanical Garden and the Rockefeller Institute, where men at both places have a long history of important fundamental biological studies.A. HildebrandT.A.



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World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol. 10, No.9, 2016

Comparative Growth Rates of *Treculia africana* Decne: Embryo in Varied Strengths of Murashige and Skoog Basal Medium

Okafir C. Uche, Agbo P. Ejinfor, Okerici C. Eziuche

Abstract—This study provides a regeneration protocol for *Treculia africana* Decne (an endangered plant) through embryo culture. Mature zygotic embryos of *T. africana* were excised from the seeds aseptically and cultured on varied strengths (full, half and quarter) of Murashige and Skoog (MS) basal medium supplemented. All treatments experienced 100% root sprouting except for half and quarter strengths. Plants in MS full strength had the highest fresh weight, leaf area, and longest shoot length when compared to other treatments. All explants in full, half, quarter strengths and control had the same number of leaves and sprout rate. Between the treatments, there was a significant difference ($P < 0.05$) in their effect on the length of shoot and root, number of adventitious roots, leaf area, and fresh weight. Full strength had the highest mean value in all the above-mentioned parameters and differed significantly ($P < 0.05$) from others except in shoot length, number of adventitious roots, and root length where it did not differ ($P > 0.05$) from half strength. The result of this study indicates that full strength MS basal medium offers a better option for the optimum growth of *Treculia africana* regeneration *in vitro*.

Keywords—Medium strengths, Murashige and Skoog, *Treculia africana* zygotic embryos.

I. INTRODUCTION

TRECVLIA africana Decne, commonly called African breadfruit (also known as "Ukwa" by the Igbo tribe), is a member of the taxonomic family Moraceae, genus *Treculia* and a multipurpose tree crop in Nigeria and Africa as a whole [1]. Propagation is by seed, but it can also be propagated vegetatively through cuttings and shield grafting. The seeds are highly nutritious and constitute a cheap source of vitamins, minerals, proteins, carbohydrates, and fats [2]. Despite its importance, little or no effort has been made to propagate the species as this valuable plant is being lost because of deforestation and urbanization, and nothing is being done about replanting the species. This, however, results in the plant declining at an alarming rate, and thus, needs priority conservation. This decline is due to non-improvement and non-cultivation of the species since it takes ten years or more to fruit. Hence, the need for mass propagation is necessary [1].

Plant tissue culture, precisely embryo culture, has been found to be the best means of mass propagating for the declining plants. Zygotic embryo culture is a technique which involves isolating and culturing of immature or mature zygotic embryos on a nutrient media under aseptic conditions. This technique helps in understanding the concepts related to nutrient requirements of the growing zygotic embryos. Murashige and Skoog (MS) medium is a plant basal medium mainly used in the laboratory for the cultivation of plant cell *in vitro*. It is the most widely used culture medium because most plant cell cultures react to it favorably. It is classified as a high salt medium in comparison to other formulations with high level of nitrogen, potassium and some of the micro nutrients, particularly boron and manganese [4].

Different studies have been conducted on growth response of *T. africana* seeds to the factors such as organic nutrient (peptidyl nutrient) [5], storage method [6], [7], but there is no literature as regards *in vitro* (seed or embryo) growth of the plant.

Thus, the objective of this study is to establish an *in vitro* regeneration protocol from the mature zygotic embryo explant of *Treculia africana* seeds in varied strengths of MS (Murashige and Skoog) basal medium.

II. MATERIALS AND METHODS

A. Site of Experiment

This study was conducted at the Tissue Culture and Molecular Biology Laboratory of the National Biotechnology Development Agency (NABDA) located at University of Nigeria, Nsukka.

B. Source of Explant

Mature fruits (Fig. 2) of *Treculia africana* Decne were collected from a tree (Fig. 3) in Umuokpame, Obo in Udena Local Government Area of Enugu state. They were identified at the Herbarium of Department of Plant Science and Biotechnology, University of Nigeria, Nsukka. The seeds (Fig. 4) were manually separated from fruits and were soaked in water for 24h then were dissected to expose the embryos which served as the explants for the study. Embryo excision was done under a dissecting microscope. Embryo explants were measured between 1.1 and 1.5 cm.

C. Stock Solutions

Stock solutions (macro elements-stock A, CaCl₂-stock B, Na₂EDTA-stock C, micro element- stock D, Myo-inositol-E, Vitamin-stock F) of [4] were used to formulate MS medium (full strength), while the composition of various stock solutions A-F was divided into two and four for 1/2 and 1/4 MS

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International Scholarly and Scientific Research & Innovation (ISSRI) 2016 364 scholar.waset.org/1307-6892/ISSRI201609

Skoog in 1962 during Murashige's search for a new plant growth regulator. A number behind the letters MS is used to indicate the sucrose concentration of the medium. For example, MS0 contains no sucrose and MS20 contains 20 g/L sucrose. Along with its modifications, it is the most commonly used medium in plant tissue culture experiments in the laboratory.[1] However, according to recent scientific findings, MS medium is not suitable as a nutrient solution for deep water culture or hydroponics.[2] As Skoog's doctoral student, Murashige originally set out to find an as-yet undiscovered growth hormone present in tobacco juice. No such component was discovered; instead, analysis of juiced tobacco and ashed tobacco revealed higher concentrations of specific minerals in plant tissues than were previously known. A series of experiments demonstrated that varying the levels of these nutrients enhanced growth substantially over existing formulations. It was determined that nitrogen in particular enhanced growth of tobacco in tissue culture. Ingredients Mammillaria miegiana on liquid MS media Major salts (macronutrients) per litre Ammonium nitrate (NH4NO3) 1650 mg/l Calcium chloride (CaCl2 · 2H2O) 440 mg/l Magnesium sulfate (MgSO4 · 7H2O) 180.7 mg/l Monopotassium phosphate (KH2PO4) 170 mg/l Potassium nitrate (KNO3) 1900 mg/l Minor salts (micronutrients) per litre Boric acid (H3BO3) 6.2 mg/l Cobalt chloride (CoCl2 · 6H2O) 0.025 mg/l Ferrous sulfate (FeSO4 · 7H2O) 27.8 mg/l Manganese(II) sulfate (MnSO4 · 4H2O) 22.3 mg/l Potassium iodide (KI) 0.83 mg/l Sodium molybdate (Na2MoO4 · 2H2O) 0.25 mg/l Zinc sulfate (ZnSO4 · 7H2O) 8.6 mg/l Ethylenediaminetetraacetic acid ferric sodium (FeNaEDTA) 36.70 mg/l Vitamins and organic compounds per litre Myo-Inositol 100 mg/l Nicotinic Acid 0.5 mg/l Pyridoxine · HCl 0.5 mg/l Thiamine · HCl 0.1 mg/l Glycine 2 mg/l Tryptone 1 g/l (optional) Indole Acetic Acid 1-30 mg/l (optional) Kinetin 0.04-10 mg/l (optional) See also Hoagland solution Long Ashton Nutrient Solution References ^ Trigliano, Robert N. & Gray, Dennis J. 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Retrieved from "@article{Murashige1962ARM, title={A revised medium for rapid growth and bio assays with tobacco tissue cultures}, author={Toshio Murashige and Folke Karl Skoog}, journal={Physiologia Plantarum}, year={1962}, volume={15}, pages={473-497}, url={ 84645704} } In vivo redox biosensing resolves the spatiotemporal dynamics of compartmental responses to local ROS generation and provide a basis for understanding how compartment-specific redox dynamics may operate in retrograde signaling and stress 67 acclimation in plants.A. M. AlnasrawiEnvironmental Science, Biology201502 levels in wild-type Arabidopsis plants and a mutant line with impaired fatty acid desaturation suggested that constitutive levels of reporter gene activity were higher in the fad7-1 background than in Col-Luc, and this method was used to establish a suitable method for measuring luminescence generated by the O2 –responsive reporter gene. The collected results suggest that the extensive photo-oxidative damage sustained by plants impaired in FNR expression was caused by singlet oxygen building up to toxic levels in these tissues, as a direct consequence of the over-reduction of the electron transport chain in F NR-deficient chloroplasts.N. ShaoGuang You DuanR. BockBiology, Environmental Science2013The identification of a small zinc finger protein, MBS, that accumulates in distinct cytosolic granules and is required for induction of singlet oxygen-dependent gene expression in Chlamydomonas and Arabidopsis is reported, indicating an important and evolutionarily conserved role of the MBS protein in ROS signaling.J. TorreyBiology1954A study of the breakdown of ribonucleic acid in tobacco leaf extracts and the distribution of certain metabolites between the chloroplasts and the remainder of the leaf suggests that iron, colorimetric o-phenanthroline method is still important.A. C. 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