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Micropropagation and *In vitro* Culture of Pyrethrum [*Chrysanthemum cinerariifolium* (Trev.) Vis.]

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ABSTRACT

Pyrethrum [Chrisanthemum cinerariifolium (Trev.) Vis. = Tanacetum cinearíaefolium (Trev.) Schultz-Bip.] is a perennial herbaceous plant belonging to the family Asteraceae, native to Albania and the area of former Yugoslavia. It is the only species in the genus Tanacetum having an agronomic importance, although the genus consists of several species producing similar types of bioactive metabolites. The species is grown in order to obtain the insecticidal compounds collectively termed pyrethrins, which are found primarily in the flower heads.

In this work we discuss the results found from a worldwide literature review about the micropropagation techniques followed on Pyrethrum, the in vitro culture conditions, and the ex vitro establishment trials under Mediterranean environmental conditions. Many technical problems concerning the propagation of the species seem to have been solved, and detailed protocols are available for an easy and fast propagation by seeds, vegetative splits, stem cuttings (rooted under mist or not), and tissue culture. The first attempts to introduce its cultivation into the semi-arid Mediterranean environments have brought to satisfactory results, and the species may be suggested as a valuable opportunity for the development strategies in new Mediterranean farming systems.

Keywords: Embriogenic callus, Mediterranean environments, Natural insecticides, Pyrethrins, Vegetative propagation.

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Pyrethrum as an Industrial Crop

The wide family of industrial crops includes all those plants that, directly or throughout the active compounds contained inside them, possess some medicinal or aromatic interest, or that may be addressed to many different uses (for cosmetic, dye, insecticidal purposes, or else). Among them, it is worth to include pyrethrum [*Chrysanthemum cinerariifolium* (Trev.) Vis.], a plant that was defined "Paramedicinal" (da Silva *et al.*, 2004), known since very ancient times due to its excellent insecticidal properties.

The species possesses interesting economical potentialities, in that it is addressed to chemical industry for the manufacturing of natural pyrethrins-based items. Despite the possibility to obtain synthetic products (Pyrethroids) that are strictly similar to natural pyrethrins, the interest towards this natural product is still very high, and the market potentialities that is possible to detect are significant.

Pyrethrum as a Crop in Mediterranean Environments

All the major world organizations (UN, FAO, EU) agree in recognizing to the multifunctionality of agriculture a crucial role for promoting a real and sustainable development of rural areas (Carrubba *et al.*, 2008). In many Mediterranean environments, that are often characterized by marginality conditions, the setting out of farming models based on such criteria is however especially difficult.

According to many experimental outcomes, a large number of pedo-climatical and socio-economical factors that confer to a territory its "marginality" conditions, may be effectively overpassed throughout the cultivation of some special industrial crop. In this scenario, the introduction of a new crop such as pyrethrum, seems to be an adequate choice in order to promote a sustainable and integrated development of rural areas, with a special reference to marginal ones. The cultivation of pyrethrum in some semi-arid environments of inner Sicily has led to interesting yields, both as total biomass and as flowers yield, even in lack of significant technical inputs (Carrubba and Ascolillo, 2009).

Origin, Importance and Diffusion of the Plant

Pyrethrum [*Chrysanthemum cinerariifolium* (Trev.) Vis.] is native to Albania and Dalmatia, a region in former Yugoslavia (Heywood, 1976).

The species is cultivated for the production of pyrethrins, that are a family of substances endowed with excellent insecticidal properties. Such properties were accidentally discovered in 1840 in Dalmatia and the large-scale cultivation and marketing of the species began in 1860 (McLaughlin, 1973).

In 1882 pyrethrum was introduced in Japan, that between the two World Wars became the major pyrethrum world producer (Purseglove, 1982). About in the 20s, also Switzerland and France became pyrethrum producers; in the same period, seeds of pyrethrum coming from Switzerland and Japan arrived to United Kingdom at the Rothamsted Experimental Station, and from there they moved to Kenya (Tuikong, 1984; Wandahwa *et al.*, 1996). Later on, also India, Tasmania, China, USA and many South America countries became pyrethrum producers. After the second World War,