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Morphogenesis of Avocado *in Vitro.* A Review

Yasseen Mohamed-Yasseen
University of Florida, IFAS, Tropical Research & Education Center, 18905 SW 280 St., Homestead, FL 33031 (Present address: 22 Salamanca Ave., Coral Gables, FL 33134)

Potential of Tissue Culture

Desirable fruit types were presumably selected by native Americans, and their seeds resulting from uncontrolled pollination were planted. Genetic improvement based on controlled pollination and selection has only been practiced in a few countries, but progress so far has been slight (Bergh, 1975; Pleigo-Alfaro and Bergh, 1992). Biotechnology has a potential for improving plant characteristics over classic breeding. The biotechnical revolution which includes cell selection, embryo rescue, protoplast fusion, and recombinant DNA technology, known as genetic engineering, all rely on tissue culture (Janick, 1992). These techniques have been recently attractive, since they overcome problems which hinder conventional breeding, by permitting the introduction of foreign genes via embryo rescue, protoplast fusion, and recombinant DNA previously unavailable to plant breeders. It also makes it possible to create genotypes via somaclonal variation, cell selection, and gene transformation. In addition, tissue culture is a highly suitable process by which a large number of plants of economic value can be reproduced on a commercial scale. At present, propagation by *in vitro* culture, or micropropagation, presents considerable advantages—being unrestricted by climatic conditions, affording a large number of plantlets from a few explants, and requiring only limited space; and consequently makes possible the rapid origination of new varieties.

Tissue culture of avocado

Several avocado explants from mature and immature embryo, shoot tip, and axillary buds from seedling and mature tree, leaf, flower, fruit mesocarp, peduncle, pollen, cotyledon, and protoplast, have been cultured in vitro. Nevertheless, the progress of avocado tissue culture is still in its early stages (Pliego-Alfaro and Bergh, 1992). Further research is needed to develop tissue culture systems with the aim of selecting or transferring some desirable traits and cloning the improved plants.

(Table 1) *Tissue culture of avocado from different explants and subsequent morphogenesis.*

Explant	Reference	Type of Morphogenesis
Mature embryo	Pliego-Alfaro and Murashige (1987)	germination
	Gonzalez-Rosas et al. (1990)	
Embryonic axes	Mohamed-Yasseen et al. (1992)	complete plant
Immature embryo	Skene and Barlass (1983)	shoot formation
	Mooney and Van Staden (1987)	somatic embryogenesis
	Pliego-Alfaro and Murashige (1988)	somatic embryogenesis
Shoot tip, and	Schroeder (1976, 1979, 1980)	shoot formation
Axillary buds	Solorzano-Vega (1989)	shoot formation
	Young (1983)	shoot formation
	Schall (1987)	complete plant
	Gonzalez-Rosas and	shoot formation
	Salazar-Garcia (1984)	shoot formation
	Schroeder (1973), Desjardins (1958)	callus
	Gonzalez-Rosas et al. (1985)[z]	complete plant
	Nel et al. (1982)[y]	complete plant
Stem	Van Lelyveld (1984)	callus
		suspension culture
Leaf	Young (1983)	callus
Flower	Schroeder (1975)	callus
Fruit mesocarp	Schroeder (1955, 1956, 1957,	callus
	1961, 1963, 1967, 1968, 1971)	callus
	Schroeder and Kay (1961)	callus
	Schroeder et al. (1962)	callus
	Gazit and Blumenfield (1970, 1971)	callus
	Blumenfield and Gazit (1971)	callus
Peduncle	Schroeder (1977)	callus
Leaf petiole	Schroeder (1973, 1977)	callus
Pollen	Sahar and Spigel-Roy (1984)	germination
Cotyledon	Kay and Schroeder (1963)	callus
	Schroeder (1968, 1977)	callus
	Gazit and Blumenfield (1970, 1971)	callus
Protoplast	Blickle et al. (1986)	callus
	Percival et al. (1991)	Protoplast

z, y: Plant material was taken for *Persea schiedeana* and *Persea indica*, relatives of avocado.

Type of Morphogenesis

Tissue cultures for different type of explants are shown in Table 1. Callus culture was established in many explants, but adventitious bud formation from callus was not accomplished. Somatic embryogenesis was obtained from callus initiated from immature embryos (Skene and Barlass, 1983; Mooney and Van-Staden, 1987; Pliego-

Alfaro and Murashige, 1988). Shoot and plant formation were successfully accomplished using embryonic axes (Mohamed-Yasseen *et al.,* 1992), and axillary buds (Schall, 1987). Considerable research is required to develop a successful protocol for in vitro regeneration and propagation of avocado.

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