PLANT & TISSUE CULTURE - C1 (Plant Tissue Culture) Cheat Sheet by woozing via cheatography.com/146689/cs/31767/

Introduction

plant cells re-differentiate

plant tissues can be regenerated from explants

Application

increase crop yield (developing countries)

produce consistent yield quality (private at-home grower)

produce exact replicas of species for profit (businesses)

Plasticity

-plant's ability to adapt and cope with changes in the environment

-plant's ability to different developmental pathways (alter their

phenotype) in response to a particular stimuli/changes in the environment

-alter its metabolism, growth, and development which suit the current environment the best

Plant cells and tissues with high plasticity is needed for plant tissue culture.

EXAMPLE: Fanwort (aquatic weed)

1. feathery underwater leaves

2. floating surface leaves

-both leaf types are genetically identical cells, but the dissimilar environments cause certain genes involved in leaf formation to be expressed or unexpressed in different environments

Plant Adaptation/Response

plastic structural	etc. growth of plant towards sunlight
responses to specific	source and growth of root towards source
environment	of water
morphological adapta-	etc. cactus's leaves are reduced to spines
tions in specific enviro-	and a stem to reduce water lost in desert
nment	

Fundamental Abilities of Plants

1.	potential of a cell/group of cells to develop into an entire
Totipo-	organism if suitably stimulated
topov	

tency

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Fundamental Abilities of Plants (cont)			
2. Dediff- erenti- ation	development of differentiated explant into a undiffere- ntiated callus (mature cells return to meristematic condition)		
3. Compet- ency??	endogenous potential of a given cells or tissue to develop in a particular way		
*Diffe- rentiation	physiological and morphological changes that occur in a cell, tissue or organ during development		
*Meris- tematic Condition	unmatured plant which does not have specific different- iated meristematic tissues (etc. apical meristem, lateral meristem) and all meristem tissues function for the 'simple growth' of the plants		
*Redif- ferent- iation	development of undifferentiated callus into planta differ- entiated		

Plant Regeneration Pathway Image



Plant Regeneration Pathway

1.	Organogenesis
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-initiation and development of tissues and organ from cells which is not meristems

a) Dedifferentiation	-starts shortly after the isolation of explant
	-rapid cell division and formation of undiffere- ntiated cells (callus)
b) Redifferentiation (budding)	-starts after the first callus cell forms

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Plant Regeneration Pathway (cont)

-tissue named organ primordia is differentiated from callus cells

-organ primordia will give rise to small meristems (cells densely filled with protoplasm and strikingly large nuclei)

-different types of specialized cells will further differentiate

-vascular system formed will connect new organs with the parent explant/callus mass

2. Somatic Embryogenesis

-dedifferentiation of plant somatic cell into totipotent embryonic stem cell then to differentiated embryos

-embryonic stem cell need to have the ability to give rise to an embryo which can further develop into a whole new plant without sexual fertilization of zygotic embryos

a)	from explants
initiated	
directly	

b) from callus initiated

indirectly

Process

1) induction of embryogenic cultures from zygotic seed, leaf or stem segment

2) further multiplication of embryos

3) mature embryos are then cultured for germination and plantlet development

4) transferred to soil

3. Histogenesis

-differentiation of undifferentiated cells and their component cell types into specific tissues and organ

*Somatic embryos - embryos form from ordinary plant cells(2n) which normally are not involved in embryo development

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Plant Tissue Culture

collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition

- 1. Appropriate tissue
- 2. Sterile conditions with aseptic techniques
- 3. Suitable growth medium

Factors Affecting Plant Tissue Culture		
1. Growth Media	-minerals, growth factors, carbon source, hormones	
2. Enviro- nmental Factors	-light, temperature, photoperiod, sterility, media	
3. Explant Source	-usually, younger, less differentiated explant is a better explant source	
4. Genetics	-different species show difference in amenability to tissue culture	
	-different genotype within a species will have variable response to tissue culture	

Explant

-small pieces of plant parts or tissues that are aseptically cut from a matured plant and used to initiate a culture in a nutrient medium

-almost all parts of plant are amenable to in vitro plant regeneration provided that they are able to dedifferentiate into totipotent cells

-to grow, it require a nutrient medium consisting of mineral salts mixture, a carbon source, (usually sucrose) and vitamins

-to initiate and maintain cell division, it need phytohormones (auxins and cytokines) in the nutrient medium

-occasionally, to ensure the prolonged growth of the excised tissue to give an established callus, other organic supplements (amino acids or hexitols) is also needed

correct choice of explant material can have an important effect on the success of a tissue culture experiment

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Explants used	in Micropropagation		Plant Explant Selec	tion (cont)
shoot tip	le	eaf tip	4. Size of explant	minimum inoculation size of explant varies
axillary bud	sl	hoot tip	(commonly: 1-1.5	according to the genotype of the plant being
inflorescence	segment no	odal segment	x 104 cells/ml)	cultured and the cultural conditions
lateral bud	flo	ower stalk segment		-large explants generally survive more frequently and grow more rapidly at the outset
leaf base	rc	pot tips		than very small ones
Plant Explant		have an important effect on		 -large explants probably contain more nutrient reserves and plant growth regulators to sustair the culture
the success of	f a tissue culture experim	ent		-smaller explant harder to culture where the
1. Season inseason of the year can affect on the contaminationwhich theand response in culture			medium of culture has to have additional components	
explant is obtained				-smaller explant increase the chance of virus elimination from subsequent cultures
2. Positi- on/part of plant	explants of various org vary in their rate of gro	gans of a same parent plant owth & regeneration	5. The purpose/ goal of the proposed culture	choice of explant tissue will vary depending on what type of a response is desired from the ce culture
	in certain plants some rative than the others	organs may be more regene-		Guidio
3. Quality of the source plant		s from healthy plants nder nutritional or water stress hibiting disease symptoms		
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Plant Explant Selection (cont)			
	a) clonal propagation	lateral or terminal shoot or bud	
	b) callus induction	cotyledon, hypocotyl, stem, leaf, or embryo	
	c) protoplast isolation	leaf tissue from aseptically germinated seed	
6. The kind of culture to be initiated	choice of explant material also determines if the plantlets developed via tissue culture are		
	a) haploid/diploid		
	b) cell/organ		
7. Physiological condition/age of the explant source	younger tissue is more responsive in vitro, usually the newest formed and is easier to surface disinfect and establish clean cultures		
	older tissue will regeneration	not form callus that is capable of	

Micropropagation

practice of rapidly multiplying stock plant material to produce a large number of progeny plants, using modern plant tissue culture methods

Advantage of Plant Tissue Culture

In plants prone to virus diseases, virus free explants (new meristem tissue is usually virus free) can be cultivated to provide virus free plants

Plant "tissue banks" can be frozen, the regenerated through tissue culture

Plant culture in approved media are easier to export than soil-grown plants, as they are pathogen free and take up little space (most current plant export is now done in this manner

Tissue culture allows fast selections for crop improvement – explants are chosen from superior plants then cloned

High degree of uniformity (true type plants) when compared to conventionally produced plants

Disadvantage of Plant Tissue Culture

It is a labor intensive & expensive process.

There is a chance that the propagated plants will be less resilient to diseases due to the type of environment they are grown in.

It is imperative that, before being cultured, the material is screened; failure to pick up any abnormalities could lead to the new plants being infected.

While the success rate is high if the correct procedures are followed, success with the tissue culture is not a guarantee. There is still a chance that the process triggers a secondary metabolic chemical reaction, and the new explants or cells' growth gets stunted, or even die off



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