**Unit D- Advanced Genetic Manipulation in Agriculture**

**Competency:BA07.00**

Outline the development of genetically modified organisms( GMO's).

**Objective: BA07.01**

Outline the stages in the development of genetically modified organisms.

Stage I- \_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Isolate a problem or concern that can be addressed through the use of genetic engineering.
* Accomplished by individual or team brainstorming, or produced from previous research results.
* Weigh the \_\_\_\_\_\_\_\_\_\_\_\_, expense, and time required to create a transgenic organism against the potential importance of the organism.

Stage II- \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Determine a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organism that will undergo modification.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can be genetically modified- often a matter of availability and expense
* Locate, isolate, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a beneficial gene sequence useful in addressing the specific problem.
  + This is usually the most difficult and time consuming part of developing a transgenic organism.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_ target \_\_\_\_\_\_\_\_\_\_\_\_\_\_ has proven particularly difficult.
  + Restriction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are used to cut DNA leaving the target Gene with “\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_” to reattach in a new organism.
* Insert the isolated gene into the target organism.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the easiest, most cost effective method for plants.
    - Utilizes an air blast or a small caliber rifle to transmit \_\_\_\_\_\_\_\_\_\_ into cells.
  + Micromanipulation is most common for the production of transgenic animals.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ & Contact Absorption of vectors are other common methods of transmission.
  + Regardless of the method, MOST cells are destroyed in the process.
* Test newly created organisms for the successful expression of genes.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are used to immediately determine the successful transformation of a transgenic organism.

Stage III- \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Test the efficiency of the transgenic organism at addressing the original problem.
  + Often the original DNA of an organism can affect the impact of the new gene \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the organism.
  + Asses the potential for the transmission of traits from the transgenic organisms in future generations.
  + Crossing transgenic individuals with individuals from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ populations is the best method to test transmission.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the second or third generation may be necessary to illuminate the impact of recessive gene sequences or traits controlled by complex heredity.
  + Marker genes will not necessarily be transmitted to offspring exhibiting the target trait, as the gene sequences are not linked.
* Markers are not necessarily indicators of the absence or presence of target genes.
  + Register the gene and organism with the proper federal agencies \_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Objective 07.02**

Discuss genetically modified organisms and their impact on agriculture

Impact of Genetically modified Organisms in Agriculture

1. USDA stats indicate \_\_\_\_\_\_\_\_\_\_ genetically engineered crops have been approved for use in the United States.

2. Bt crops have proven to be among the most economically and environmentally important transgenic organisms.

Thousands of acres of \_\_\_\_\_\_\_\_ Corn, Soybeans, Cotton and other crops are planted world wide each year.

More than \_\_\_\_\_\_\_\_% of Soybeans produced in the US contain the Bt gene coding for insect resistance.

3. The first genetically engineered crop approved for human consumption was the FlavrSavr \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in \_\_\_\_\_\_\_\_\_\_\_.

The tomato was engineered to last longer in storage without degradation of taste or appearance.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Tomatos did not prove to be economically efficient.

**Objective 07.03**

Explain considerations in the selection and isolation of genes for use in modifying an organism.

Selecting Genes for Use in the Creation of Genetic Engineering

1. Mapping the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a Species.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ animals have had specific gene sequences removed to determine the function of the missing sequences.

Must be compared to “normal” organisms exhibiting the missing genes.

2. Field testing ensures no dangerous unintended consequences occur.

3. Extracted DNA can be broken into specific gene segments through the use of markers and restriction enzymes.

Restriction enzymes \_\_\_\_\_\_\_\_\_\_\_ DNA.

Markers may be radioactive

Indicates the size and/or location of a gene sequence.

Rules for Genetic Manipulation

1. In theory, scientists can remove any \_\_\_\_\_\_\_\_\_\_\_\_ from any living organism for insertion into any other living organism.

Researchers must find a way to introduce the gene into the target organism

It is usually no more difficult for unrelated organisms.

2. Avoid using genes from organisms known to carry common \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to produce genetically modified foods.

Allergens may or may not be tied to certain gene sequences, thus researchers must be careful when choosing genes for insertion into commodities.

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Genes

Controversial issue as both profits and expenses can be great.

Disagreement often hinges on the benefits of the gene as well as the methods used to create and extract or insert the gene

Governments hesitate to award patents on single genes removed from naturally occurring organisms.

A single isolated gene can be used to make many different types of organisms

**Objective 08.01**

Explain the Various Methods for the insertion of vectors containing rDNA into plant cells

A Using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to Insert DNA

Attach gene sequences to their own DNA, which is then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into the DNA of the target organism

Examples are:

* Bacteriophages and other \_\_\_\_\_\_\_\_\_\_\_\_\_
  + inject DNA into target cells
* Some true bacteria- including Agrobacterium tumefaciens
  + causes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ plants altering the DNA of the cells in the area
* Utilize \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + small rings of DNA inside the tough protein coat of the virus

Methods of Transmitting Vectors

* Vectors can be inserted into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ wounds, placed into contact with exposed \_\_\_\_\_\_\_\_\_\_, or simply placed in physical contact with dermal tissue.
  + Simple plants like \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can be transformed simply by exposure to a liquid solution containing bacterial vectors.

Physical Methods of Genetic Manipulation

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- utilizes electric current to merge genetic material.
  + DNA sequence is placed close to the cells into a solution that is then exposed to and electrical charge
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- a tiny syringe is used under a microscope to inject DNA through a cell membrane
  + Most widely used in gene splicing of animals
  + For both micromanipulation and electroporation, the cell wall must be removed in plants for the process to be successful.
    - Plant cells with the cell wall removed are called-photoplasts
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Uses air or gun powder to fire a gold coated projectile covered with target DNA into a mass of cells.
  + Most effective method for \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_.

**Objective8.02**

Discuss techniques for the creation of transgenic animals

**The process of creating \_\_\_\_\_\_\_\_\_\_\_\_\_ animals**

1. Usually requires using reproductive cells (usually fertilized eggs or stem cells).
   1. these are the only animal cells able to differentiate and form new animals.
2. Most transgenic animals are created by utilizing the process called micromanipulation.
   1. most accurate process which produces the fewest casualty cells compared to electroporation, biolistics, and other different methods
   2. cells can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (removal of all DNA from the cell or the embryo) and a new DNA sequence can be inserted.

An alternate method of micromanipulation can be used by researchers attempting to insert the single DNA sequence into the target cells \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (plural: pronuclei) is the nucleus of a sperm or an egg cell during the process of fertilization, after the sperm enters the ovum, but before they fuse. Sperm and egg cells are haploid, meaning they carry half the number of chromosomes. When the pronucleus of a sperm fuses with the pronucleus of an egg, their chromosomes combine and become part of a single diploid nucleus in the resulting embryo, containing a full set of chromosomes.

**Issues and problems with creating transgenic organisms**

1. There are more problems with transgenic animals than plants because they are more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and more difficult to create.
   1. Creation of transgenic animals usually requires the use of specialized reproductive cells
      * 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells, stem cells, embryos, or haploid cells
        2. \_\_\_\_\_\_\_\_\_\_\_\_\_ cells are \_\_\_\_\_\_\_\_\_\_\_ and others cells that give rise to the development of gametes (Gonocytes)
   2. Animals cells has a smaller chance of surviving the process of genetic manipulation
   3. Out of over \_\_\_\_\_\_\_\_\_\_\_\_\_ attempts to make offspring from genetic manipulation, only one was successful, which is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the sheep
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells has great potential for cloning and genetic manipulation in animals
   1. The only way to obtain new offspring is by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of developing embryos

**Objective: BA08.03**

Analyze the development of genetically modified plant and animal cells after insertion of recombinant DNA

Genetically Modified Plant Cells

* After a plant cell has been inserted with genes.
  + cells are cultured \_\_\_\_ \_\_\_\_\_\_\_\_\_\_, from small amounts of material large numbers of plantlets are produced
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ genes are used in cells, really easy to incorporate, and can be tested immediately after germination.
    - they are used to identify transgenic organisms after the separation of plant shoots or after birth of the animal.
  + \_\_\_\_\_\_\_\_\_\_\_ plants are kept in a control environment and kept away from natural populations.

Genetically Modified Animal Cells

* \_\_\_\_\_\_\_\_\_\_\_\_\_ % is the percent that the GM Animal embryo will develop into a full turn animal.

Animal cells can be:

* Flash \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and kept at constant sub zero temperatures to be stored \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + the cold storage must be done immediately (if done correctly it has little effect on the embryo viability)
* Placed into a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ woman's womb for the embryo to develop.
  + chances of embryo surviving is slim even after a successful transfer procedure.

GM Animals

* Many animals have been Genetically Modified over the years