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Unit -2
Plant Genetic Engineering
Promoters used in Plant vectors

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Promoters used in Plant Genetic Engineering

In plant genetic engineering, **promoters** are crucial regulatory sequences that drive the expression of a gene in the target plant. They are typically located just upstream of the gene of interest and control the initiation of transcription, ensuring that the inserted genes are expressed in the plant cells in the desired manner. Understanding the various types of promoters and their function is vital in the context of plant genetic engineering.

1. Function of Promoters

Promoters play a key role in the **transcriptional regulation** of genes. They are recognized by the RNA polymerase and other transcription factors that together facilitate the process of transcribing the gene into messenger RNA (mRNA). In genetic engineering, promoters are carefully selected to ensure:

- **Spatial specificity:** Expression of the gene in particular tissues (e.g., root, leaf, seed).
- **Temporal specificity:** Expression at a particular developmental stage or under certain environmental conditions.
- **Strength:** The level of gene expression, which can range from very high to low.

Types of Promoters

1. Constitutive Promoters:

- **Definition:** These promoters drive gene expression continuously in all tissues, throughout the plant's growth stages.
- **Examples:**
 - **Cauliflower Mosaic Virus (CaMV) 35S Promoter:** One of the most commonly used constitutive promoters. It provides high-level gene expression in a wide range of plant species.
 - **Rice Actin Promoter:** A strong promoter from rice that drives consistent gene expression across various plant species.
 - **UBIQUITIN (Ubi) Promoters:** Derived from plant ubiquitin genes, these promoters lead to stable, ubiquitous expression in many plant tissue,

2. Tissue-Specific Promoters:

- **Definition:** These promoters drive gene expression only in specific tissues or organs.
- **Examples:**
 - **Patatin Promoter:** Derived from the potato tuber, it specifically drives gene expression in tuber tissue.
 - **RUBISCO (Rubisco small subunit) Promoter:** Used for expression in chloroplasts, particularly in photosynthetic tissues like leaves.
 - **Soybean Glycine Betaine Synthase (GBS) Promoter:** Targets gene expression to specific tissues, such as roots.

Types of Promoters

3. Inducible Promoters:

- **Definition:** These promoters are activated by external stimuli, such as chemicals, light, or temperature, allowing for controlled expression of the inserted gene.
- **Examples:**
 - **Ethanol-inducible Promoter (e.g., alcohol dehydrogenase promoter):** Used to activate gene expression in the presence of ethanol.
 - **Heat Shock Promoter:** Responds to temperature stress, commonly used to induce gene expression in response to elevated temperatures.
 - **Dex-inducible Promoter:** The **DEX (dexamethasone)-inducible** promoter is activated by the chemical dexamethasone, allowing controlled gene expression in research.

4. Seed-Specific Promoters:

- **Definition:** These promoters drive gene expression specifically in seeds during germination or seed development.
- **Examples:**
 - **Glutenin Promoter:** Used for expressing genes specifically in wheat seeds.
 - **Phaseolin Promoter:** A seed-specific promoter in beans, used for expressing genes in the seed during the later stages of development.

Types of Promoters

5. Promoters from Viruses and Transposable Elements:

- **Definition:** Viral and transposon-based promoters often exhibit strong and broad expression patterns, making them useful in various genetic engineering contexts.
- **Examples:**
 - **Cauliflower Mosaic Virus 35S:** As mentioned earlier, a highly used viral promoter for constitutive expression.
 - **T-DNA (Agrobacterium) VirE2 Promoter:** Used for specific applications involving Agrobacterium-mediated transformation.

6. Enhancer Elements:

- **Definition:** Although not strictly promoters, enhancer elements are sequences that can work in conjunction with promoters to enhance their activity.
- **Examples:**
 - **CBP (Core Binding Protein) enhancer sequences:** Used to enhance the activity of nearby promoters, improving gene expression.



Thank you