North Dakota State University
PLSC 731: Plant Molecular Genetics

On-Line Learning Study Guide
Map-Based Cloning of Plant Genes: Learning Objective Comments Included

The following is your on-line study guide for the topic of "**Map-Based Cloning of Plant Genes**". You have access to the following resources at this WWW site:

- **Highlighted .pdf Notes** (used in the on-line lecture)
- **Graphic Notes** (used in the on-line lecture)
- **On-Line Lecture**
- **Manuscripts (5)**

Learning Objectives

1. Understand the **basic principles** of map-based cloning of genes controlling qualitative traits
   - **Locate gene to a chromosome position with low-density markers**
   - **Develop co-segregating (or nearly co-segregating) markers linked to gene**
   - **Locate the gene to a large-insert-size clone or physical position in the reference genome sequence**
   - **Select the gene and perform genetic complementation and/or mutational analysis**
2. Understand the **differences** between map-based cloning of genes controlling qualitative and quantitative traits
   - **The phenotypic distributions are different and, thus, the initial genetic analysis is different**
3. Be able to explain the steps and results of the **recombination mapping experiments** and there importance for defining the interval that contains the candidate gene
   - **Search for a recombinant individual by looking at a large F2 population or a population of genotypes with alternate phenotypes for the trait**
   - **Screen with markers to determine the gene (based on phenotypes) is located between two markers**
   - **When using large-insert clones, prove the markers on either side of the gene are located on the clone**
4. Describe the concept of **genetic complementation** and the role of transgenic plants in proving the candidate gene indeed controls the phenotype
   - **The wild type candidate gene should convert a genotype with a mutant phenotype to a wild type phenotype when it is introduced into the mutant genotype**
   - **Insert the candidate gene in a transformation vector and used to develop a transgenic mutant genotype**
   - **Screen the transgenic plant and score the phenotype**
   - **If the transgenic plant has the wild type phenotype, the candidate gene is indeed the gene controlling the phenotype**

Activities

1. View the **On-Line Lecture** which is ~1 hr long if you view it without stops. I would suggest that you first print out the **Highlighted .pdf Notes** and **Graphic Notes** and go over them before watching the lecture. This way, in general, you will be familiar with the material that will be covered in the lecture.

2. Read all (or at least the assigned parts) of the five manuscripts

- *Pto*: Martin et a 1993
    - All
- *fw2.2* background: Alpert and Tanksley 1996
    - Abstract
    - Introduction
    - RESULTS AND DISCUSSION: Sections 1, 2, 3, and 5 (and related Figures and Legends)
- *fw2.2*: Frary et al. 2000
    - All
- *Hd1* background: Yamamoto et al. 1998
    - Abstract
    - Introduction
    - Results: Section 2
    - Discussion: Sections 1, 4
- *Hd1*: Yano et al 2000
    - All

Reflections on the Manuscripts

When (and after) reading the manuscripts, you should develop answers to the following questions:

- Why are the three traits studied in these manuscripts important? Are the traits still relevant for modern plant breeding? How might the results for a specific crop be applied to another crop species?
- When the experiments described in the Martin et al., Frary et al., and Yano et al manuscripts began, what data/results were available to the researchers? How were that data/results used as the starting point for the research described in the their papers?
- Consider the nature of the populations used for the recombination mapping steps and describe how they were developed.
- Each project discovered a candidate gene and proved it indeed rescued the dominant phenotype by genetic complementation. What general conclusion, if any, can be drawn regarding the function of the genes and how they control phenotype?
- If the researchers began their experiments today, how might the experimental design be different?