Testing for GMO Traits with Lateral Flow Strips

Genetically Modified Traits (GMOs) were first commercialized in US crops in the 1990's. GMO crops have transgenic traits, which means that genes from one species were artificially transferred from one species to another. Before a GMO trait can be commercialized and made available to consumers in the US, the product has to undergo extensive testing to ensure its safety for human consumption and the environment. Today most of the corn, cotton, and soybean grown in the US have GMO traits and there have been no documented cases of negative health effects upon people or animals.

For plant breeders, it is important to track these GMO traits within their programs to which breeding line has the trait it is supposed to contain and to verify that no unwanted traits are in the plants. GMO traits are simply inherited traits in that they are passed from parent to offspring in the same way that the Austrian Monk, Gregor Mendel, described in the 1860's. We call this Mendelian Inheritance.

One of the most commonly used GMO detection systems is a lateral flow strip test, which is a relatively low cost method of GMO testing. These strips are thin pieces of a nitrocellulose membrane covered by a sample pad on one end and a wicking pad on the other end. The sample pad is submersed in a solution of the test sample. The solution wicks up the nitrocellulose membrane on the strip, causing the fluid to pass over an area containing an excess of gold-labeled antibody specific to the GMO protein being tested. If that specific GMO protein is present in the sample then it will bind to the gold-labeled antibody, and the antibody-protein complex will continue moving up the strip with the fluid.

The fluid then passes over two more areas on the strip, a test line and a control line. The test line contains a second antibody which is specific for the GMO protein being tested. When the gold-labeled antibodies that are bound to the GMO proteins pass over the test line, the antibody-protein complex forms a visible line on the strip indicating a particular GMO protein is present in the sample. Excess unbound gold-labeled antibody continues to flow up the strip and passes over the control line which contains a third immobilized antibody specific for the gold-labeled antibody. When the excess gold-labeled antibodies bind to this immobilized capture antibody, it produces a second visible line that serves as an internal control to ensure that gold-labeled antibodies have passed through all three check points.

The sample is considered positive for the GMO protein of interest if the test and control lines are visible whereas the sample is considered negative for the GMO protein if only the control line is visible. Absence of both lines indicates that the test is invalid and should be repeated.

Lateral flow strips (LFS) can only detect the presence or absence of a GMO trait. They cannot quantify the amount of GMO protein in the sample. They also cannot determine if the GMO trait is in the homozygous or heterozygous state (co-dominance detection). So plant breeders will

sometimes compare LFS results to expected Mendelian genetic ratios and by using a Chi-Square analysis, plant breeders can determine the segregation pattern.

Exercise:

1. Remove a portion of the plant's leaf and grind it with a pestle in a buffered water solution in a microtube. Only fill the tube halfway full with the buffered water.
2. Place the lateral flow strip into the microtube and allow the sample solution to wick up the strip for 2-3 minutes until the control line is visible.
3. If other lines appear beneath the control line, this indicates that a GMO trait is being expressed in the plant.

Image of a LFS with three GMO traits identified by marker lines and a control line.

Image of the LFS, microtube, pestle, and cotton seedling that has been sampled.

Discussion questions:

1. Do you feel comfortable consuming GMO plants? Why or why not?
2. Why is it important for plant breeders to identify plants with GMO traits in their breeding programs?
3. Why are LFSs commonly used by plant breeders?