# Mutations and Mendelian Genetics

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## Purpose:

* To reinforce understanding of gene action and differences that can exist between populations from crosses and their reciprocal crosses.
* To emphasize understanding of use of Chi-square test of hypothesis and interpretation of results.
* To reinforce understanding of segregation patterns following self-fertilization from generation to generation.

**Keywords**: mutant, mutagenesis, population, reciprocal cross, herbicide, gene action; self-fertilization

**References:** [***Genetics, Agriculture, and Biotechnology***](https://iastate.pressbooks.pub/genagbiotech/)***,* Chapters 3, 13**

## Background

A homozygous mutant plant resistant to the herbicide glyphosate was obtained by chemical mutagenesis of soybean, a self-pollinated diploid species. Single nucleotide mutation in the soybean enzyme 5-enolpyruvylshikimate 3-phosphate (EPSP) synthase gene confers resistance to glyphosate.

Reciprocal crosses between the mutant plant and its progenitor cultivar, Red, were made and a total of six F2 populations were obtained. They were treated with the herbicide roundup, which contains the active ingredient glyphosate. Table 1 shows the number of plants that either survived (Not injured or injured) or died after herbicide treatment, and the Chi-square test results, for three populations.

**Table 1.** Phenotypic evaluation of F2 populations derived from the crosses between the mutant and progenitor Red.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Survived (F2) after glyphosate treatment** |  | **χ2** |
| **Crosses** | **Plants tested** | **Not injured** | **Injured** | **Total** | **Killed** | **Value** | **Probability** |
| Mutant x Red 1 | 121 | 69 | 20 | 89 | 32 |  |  |
| Mutant x Red 2 | 129 | 91 | 10 | 101 | 28 |  |  |
| Mutant x Red 3 | 211 | 157 | 2 | 159 | 52 |  |  |
| **Pooled Total** | **461** | **317** | **32** | **349** | **112** |  |  |

1. Calculate the Chi-square values and probabilities for the crosses in Table 1.
2. Based on Table 1, is the herbicide resistance trait controlled by a single gene or multiple genes? Justify your answer.

Is the gene action for the herbicide resistance gene dominant or incompletely dominant? Justify your answer.

1. What gene inheritance model supports the data?