

Public Abstract

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Title:The Effects of Aneuploidy on Gene Expression in a Dosage Series of Maize Chromosome Arm 1L

Aneuploidy is a class of genetic conditions involving an unbalanced number of chromosomes. The most familiar human aneuploid condition is trisomy 21, called Down syndrome. Aneuploid conditions necessarily involve a change in the dosage of those genes which are located on the varied chromosome. However, the dosage level of a gene does not automatically correspond to the amount of RNA or protein that will be produced *in vivo*. Based on previously published studies, the impact of chromosome dosage changes on the transcription of single genes may be direct, inverse, or anywhere in between; and genes may be impacted anywhere in the genome, not just on the varied chromosome.

Using a maize model system, a dosage series of plants was produced in which sibling plants are identical, except for the copy number of chromosome arm 1L. These plants were grown until 45 days post-germination, at which point leaf tissue was collected for RNA extraction. This dosage series included 5 dosage levels for comparison: diploid, trisomic, tetrasomic, haploid, and disomic haploid. A second dosage series was grown up to day 55, and included diploid, monosomic, and trisomic. Using RNA sequencing, expression levels for all genes were determined. The results were analyzed in aggregate, allowing for a view of effects on the level of the whole transcriptome.

Results suggest that dosage of genes on the varied chromosome region has some correlation with expression of those genes, though the change compared to a diploid is often partial. Inverse relationships between chromosome dosage and RNA expression of genes elsewhere in the genome are seen to occur. Both direct and inverse reactions were amplified by increased levels of genomic imbalance. The kinetics of interacting proteins and other cellular components, as described in the gene balance hypothesis, may be the mechanism leading to these responses.

Using the same methods of analysis, similar phenomena were observed in aneuploid/euploid comparisons in other organisms. Partial dosage compensation and inverse effects were observed in published datasets from aneuploid yeast and mouse. A set of trisomics in *Arabidopsis* displayed the same effects, though to a different extent in different trisomies. Using a published database of transcription factors, the responses of genes to dosage changes of their regulators was analyzed. A number of cascade effects were observed, in which inverse relationships of transcription factor dosage and target gene expression occurred sequentially, disrupting normal regulation of several genes in a network by changing the dosage of a single component.