Investigating the Roles of NDJ1 and TID1 in Distributive

Segregation Using Non-Exchange Chromosomes

A Thesis

presented to

the Faculty of California Polytechnic State University,

San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Biological Sciences

by

Jonathan V. Henzel

May, 2010

ii

COMMITTEE MEMBERSHIP

TITLE: Investigating the Roles of NDJ1 and TID1 in
                          Distributive Segregation using Non-Exchange
                          Chromosomes

AUTHOR: Jonathan V. Henzel

DATE SUBMITTED: May, 2010

COMMITTEE CHAIR: Dr. Kenneth Hillers, Assistant Professor

COMMITTEE MEMBER: Dr. Michael Black, Associate Professor

COMMITTEE MEMBER: Dr. Ed Himelblau, Assistant Professor

ABSTRACT

Investigating the Roles of NDJ1 and TID1 in Distributive

Segregation Using Non-Exchange Chromosomes

Jonathan V. Henzel

Meiosis is a specialized cell division that leads to a reduction of ploidy in sexually reproducing organisms through segregation of homologous chromosomes at the first meiotic division. Improper segregation of chromosomes during meiosis results in anueploidy, which is usually fatal during embryonic development. The meiotic process is therefore tightly regulated. Typically, proper segregation of homologs at meiosis I requires pairing of homologous chromosomes, followed by crossover recombination between homologs. Crossovers enable proper chromosomal segregation during the first meiotic division in part by establishing tension in the meiotic spindle. However, in the absence of crossovers, some cells maintain the ability to direct homologous chromosomes to opposite spindle poles, through a poorly understood mechanism known as distributive segregation.

We are using the common brewers yeast *Saccharomyces cerevisiae* to determine possible roles of two genes in distributive segregation. The genes of interest, Ndj1 and Tid1, have been previously demonstrated to play a role in crossover interference, but their roles in distributive segregation are not well understood. Ndj1 has been shown to function in the tethering of telomeres to the nuclear envelope and may aid in the homology search chromosomes undergo. Tid1 has been characterized as a recombination accessory factor and may stimulate crossovers by directing recombinases to double strand break sites early in meiosis. To assay distributive segregation, we use yeast in which crossing over between one chromosome pair is prevented (due to sequence divergence). Using this system, we can assay the ability of yeast to carry out distributive segregation. Our results indicate that mutations in Ndj1 impair the ability of yeast to carry out distributive segregation, while mutations in Tid1 do not affect distributive segregation. These results, in turn, suggest that Ndj1 may play a role in distributive segregation. This experiment is part of a larger question to determine whether crossover assurance and crossover interference are independent mechanisms.

iv

ACKNOWLEDGMENTS

I would like to acknowledge several people for assisting me in the compilation of this thesis. I would like to thank my advisor and committee chair, Dr. Ken Hillers, for all of his advice and guidance throughout this project. Without his help, I would not have been able to achieve any success in science. In addition, I would like to thank Dr. Betsy Turner for all of her help in making my transition into science much smoother than it would have been otherwise. Both Dr. Hillers and Dr. Turner provided much more than just educational support and I will be forever grateful. I would like to acknowledge Dr. Michael Black and Dr. Ed Himelblau for comments, encouragement and general mentoring throughout my time at Cal Poly. You have both made me a better scientist and a more effective teacher. I would also like to acknowledge Dr. Eva Hoffman and Louise Newnham for supplying the yeast strains and encouragement to get the project started. Lastly, I would like to thank Rianna Knowles for assistance with data collection for this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES