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Title: REDUCTION OF SATELLITE DNA TRANSCRIPTION ENHANCES DRIVE IN SEGREGATION DISTORTION

Abstract

Meiotic drivers are selfish genetic elements that bias their transmission during gametogenesis. One of the well-known examples is Segregation Distorter (SD) in Drosophila melanogaster. SD heterozygous male flies transmit the SD chromosome to nearly all of their progeny (>95%). Two key components have been identified in the SD system: the driver, Segregation distorter (Sd), and its target, Responder (Rsp). Sd encodes a truncated duplication of the gene RanGAP, and Rsp corresponds to tandem satellite DNA (satDNA) repeats. Besides these two key components, there are different modifiers of SD in the genome that are also critical for the strength of drive. Different SD haplotypes exist in natural populations, and while all SD chromosomes have Sd-RanGAP, they may differ in their modifiers. SD targets Rsp-bearing sperm for destruction, however, the role of Rsp in this process and how is it targeted by SD remain unknown. To test if Rsp transcripts play roles in SD drive, we performed RNA-seq to detect the expression level of Rsp in testes with or without SD. We found that satDNAs show reduced expression levels, and generate fewer piRNAs in the presence of SD, while the expression level of other types of repeats like transposable elements (TEs) and genomic piRNA clusters remain unchanged, suggesting that the disrupted expression is exclusive to satellites. Furthermore, overexpression of Rsp piRNA populations lead to reduced drive phenotype, confirming that the reduction of Rsp transcripts is important for SD drive. However, this reduction of Rsp is specific to one SD haplotype (SD-Mad), but not in another SD haplotype (SD-5), suggesting that the Rsp piRNA disruption is not due to Sd-RanGAP, but instead another locus on the chromosome. These two SD haplotypes likely differ in their modifiers of SD and these modifiers may enhance drive by affecting Rsp expression. In summary, our results suggest that Rsp satDNA regulation is disrupted at least in some SD haplotypes, providing insights into our understanding of the role of Rsp in meiotic drive.