Discovery of a functional RNA that has opposed regulatory functions

The RNA responsible for both up- and down-regulation of specific gene expression

We have discovered a functional noncoding RNA that is involved in both up- and down-regulation of gene expression. The RNA called U7 is involved in two distinct regulatory mechanisms in histone gene expression. Histones form chromosome cores by associating with genomic DNA. Since histones are highly basic proteins, the free histones unbound with DNA are harmful to the cells. Therefore the histone synthesis is strictly restricted within S phase where DNA is replicated during a cell cycle. U7 RNA is a small noncoding RNA involved in histone mRNA processing to facilitate histone synthesis in S phase. Here we discovered another role of U7 RNA out of S phase, where U7 is required for silencing of histone gene transcription to avoid extra histone synthesis. The ultrasensitive mass spectrometry identified hnRNPUL1 as a novel U7 RNA-binding protein that is specifically involved in transcriptional silencing function of U7. The dual functions of U7 RNA are expectedly applied for designing an artificial gene switch to regulate cell functions.

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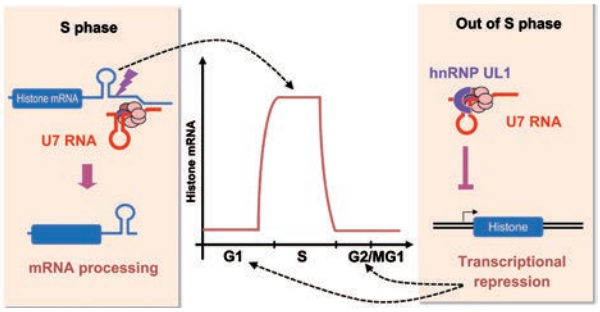

Distinct cell condition-dependent regulations of histone gene expression conducted by U7 RNA

Discovery of symbiotic bacteria mediating insecticide resistance to pest insects

Overturns conventional understanding that insecticide resistance is determined only by the pest insect's own genome

We have discovered that bean bugs (*Riptortus pedestris*), a kind of pest insect that attacks soybean crops and is difficult to control, develop insecticide resistance by acquiring insecticide-degrading bacteria from environmental soil and allowing them to live symbiotically in their bodies. To date, insecticide resistance has been reported in approximately 500 species of pest insects worldwide, causing serious problems for agriculture and public health. It has conventionally been believed that insecticide resistance is determined only by the genes of pest insects themselves. However, this new discovery overturns this conventional understanding, presenting a new perspective on the evolution of insecticide resistance in pest insects and for planning strategies to control pest insects.

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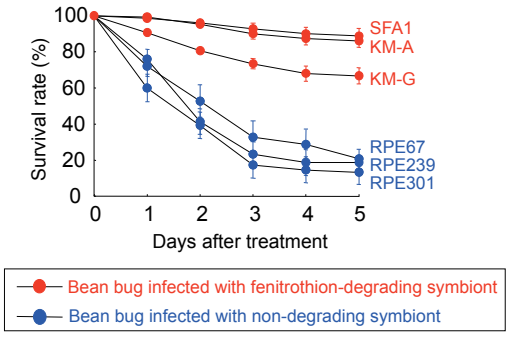
A bean bug on a soybean leaf



Survival rates of bean bugs after fenitrothion treatment
Almost none of the specimens died if they were infected with fenitrothion-degrading bacteria.