

**IOWA STATE UNIVERSITY
Institutional Biosafety Committee**

Guidance for the Use of Gene Drive Technology in Research

Background

The Institutional Biosafety Committee (IBC) at Iowa State University recognizes that editing genetic material is an important part of some aspects of research. Genomic editing is done through the use of various tools such as Clustered Regularly Interspaced Short Palindromic Repeat (CRISPR)/cas, transcription activator-like effector nucleases (TALEN), and zinc finger nucleases. While this technology offers efficient and quick gene editing, it also has the potential to create gene drives, which present some risks and safety issues.

Definition of Gene Drive and associated risks

Gene drives are systems that result in the proliferation and spreading of specific genetic changes throughout a sexually reproducing population at a greater rate than Mendelian genetics would predict.

One type of gene drive that is of particular concern is the use of CRISPR/Cas technology. The CRISPR/*cas* gene drive technology uses a *cas* gene (e.g., *cas9* or *cas12a*), which acts as a molecular scissors to cut DNA at a site directed by the *guide RNA*, which tells the *cas* gene where to cut the DNA. This can allow for the insertion of DNA of choice, giving rise to an altered gene. When this occurs in a germ line, it produces an organism that is transgenic for the gene of choice. It can also allow for small insertions or deletions through non-homologous end-joining following the double strand break caused by the Cas enzyme.

There are several concerns with the use of gene drive technology. One concern is if the altered gene occurs on both alleles, this would allow for the alteration in genetic code to be passed to subsequent generations and eventually the entire population at a much higher rate. That is to say, there would be continuous integration of genetic changes through multiple generations. This occurs at high frequency when the components of the drive are on one genetic element that can be passed intact to subsequent generations or populations.

Another concern with the use of gene drive technology is the inadvertent release of organisms into the environment. Thus, a thorough risk assessment is recommended for research that involves gene drive technology, or genetic modifications that have the potential to result in gene drive. Researchers should evaluate their containment plans and assess the potential for escape or release into the environment. Additionally, a plan of action should be in place were escape or release to occur. Researchers are encouraged to use safeguards like organisms that cannot reproduce outside the lab with native species or barriers to prevent escape in the first place.

The IBC captures portions of the risk assessment through the a-tune IBC protocol form and therefore the use of gene drive technology will be evaluated by the committee prior to use.

Plant containment guidance

For projects that involve the use of gene drive technology in plants, the IBC recommends the following practices:

1. Clearly label seed that carries CRISPR/*cas* transgenes.
2. Store seed in a secure location.
3. Segregate seed of CRISPR/*cas* lines from other seed.
4. Clearly label plants in greenhouse or growth chamber and segregate from non-transgenic plants.
5. For outcrossing plants, contain the pollen, for example bag the tassel of maize plants. Perform controlled crosses and selfings.
6. If planting in the field, obtain required permissions, and be aware of the possibility of gene drives when using CRISPR/*cas*.
7. Develop a plan of action for the accidental environmental release of gene drive material.

Animal containment guidance

For projects that involve the use of gene drive technology in vertebrate or invertebrate animals, the IBC recommends the following practices:

1. Strictly adhere to the correct BL/BLN designations and containment levels.
2. Develop a plan of action for the accidental escape of an animal or insect that carries gene drive potential.

Resources

Akbari, O.S., H.J. Bellen, E.Bier, et. al. 2015. Safeguarding gene drive experiments in the laboratory. *Science*, 349 (6251), 927-929. <http://science.sciencemag.org/content/349/6251/927>

Frequently Asked Questions about Risk Assessment and Personal Protective Equipment:

<https://www.compliance.iastate.edu/sites/default/files/imported/ibc/guide/docs/FAQs--Risk%20Assessment.pdf>

National Institutes of Health (NIH) Guide for Risk Assessment templates:

Example Risk Assessment templates from NIH:

[Influenza Viruses](#)

[Recombinant Influenza Virus Containment](#)

[Coronaviruses](#)