Can RNA interference technology contribute to controlling Asian citrus psyllid in Florida?

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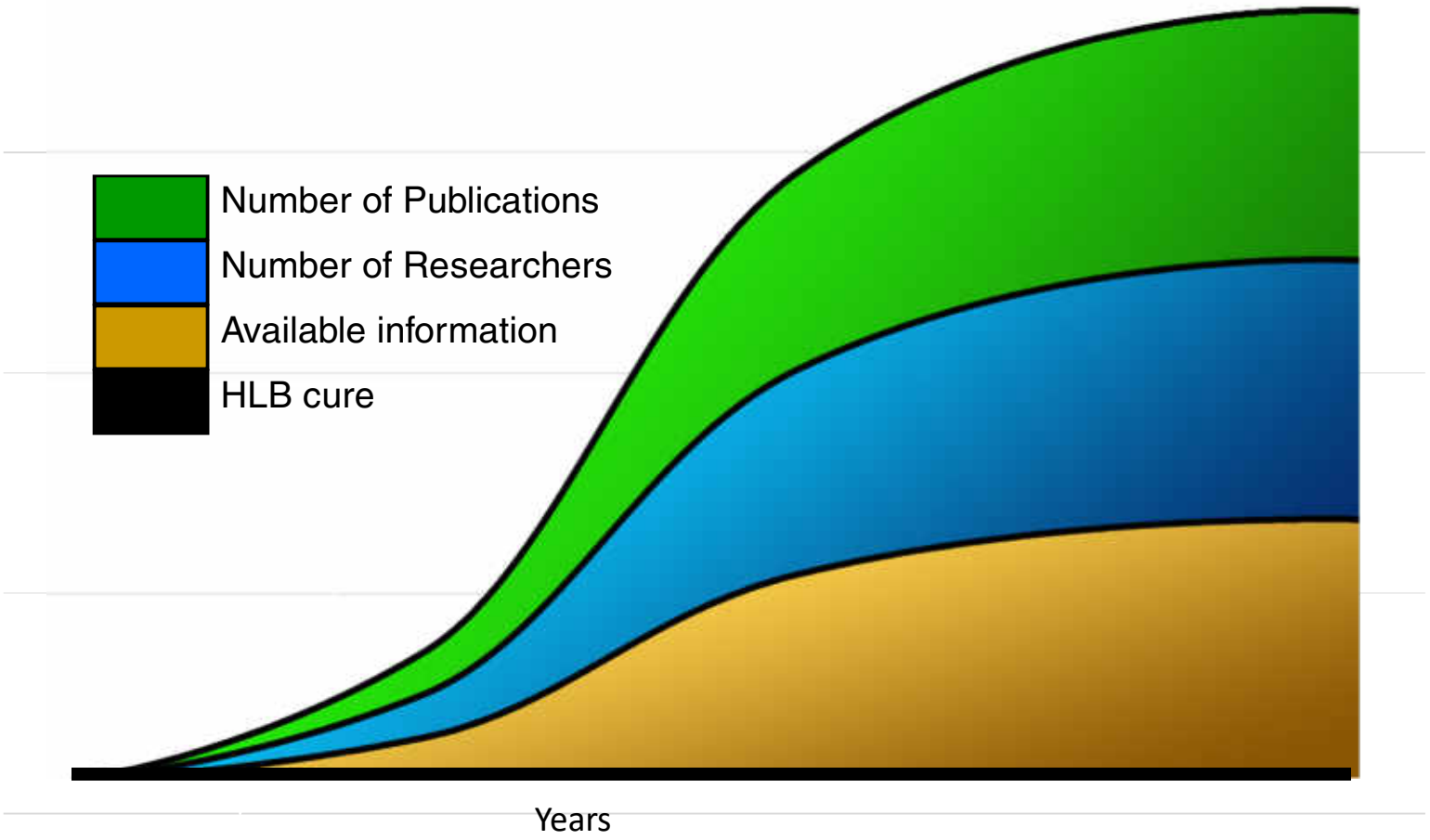
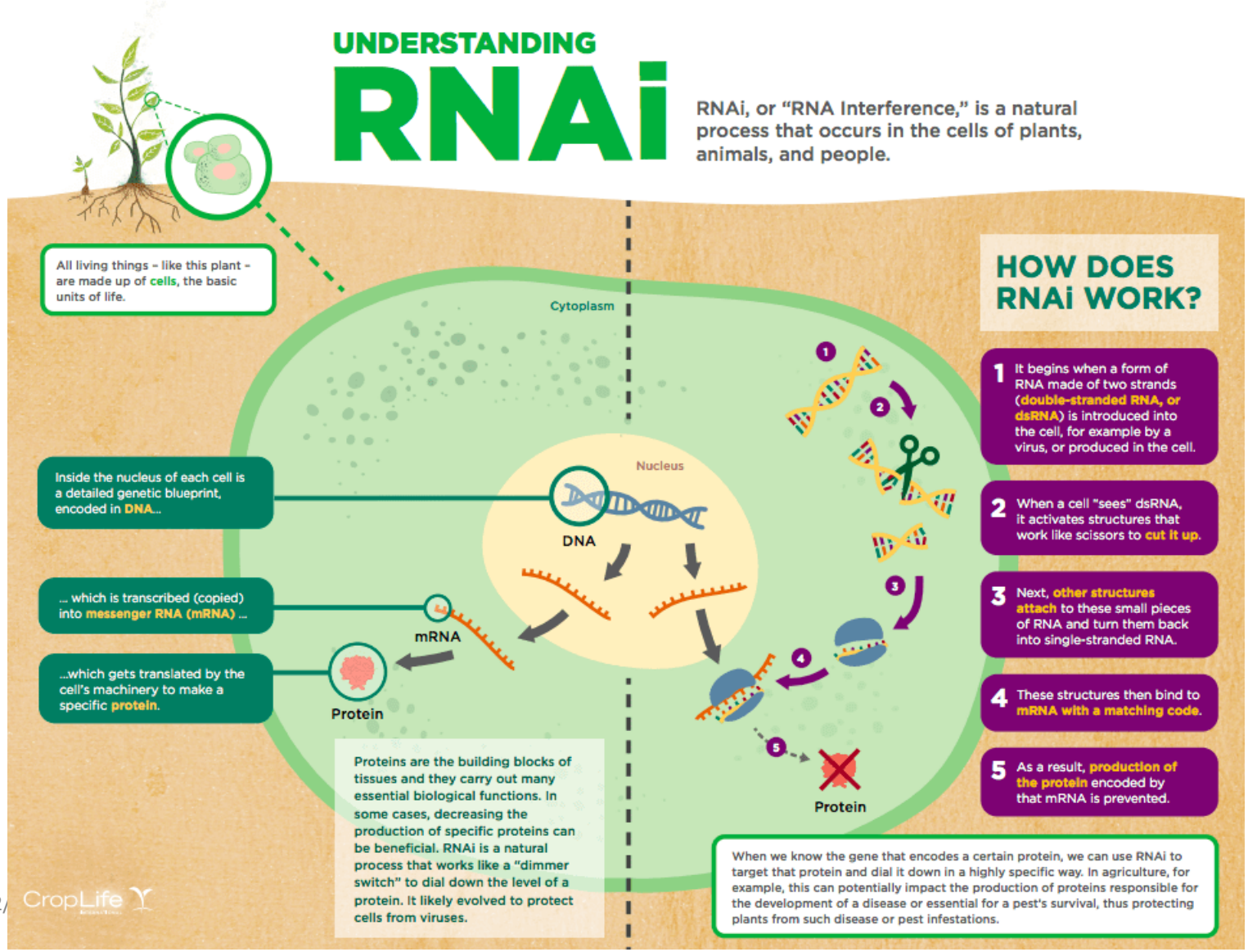
BEST SOFA FOR
UNWANTED GUESTS...

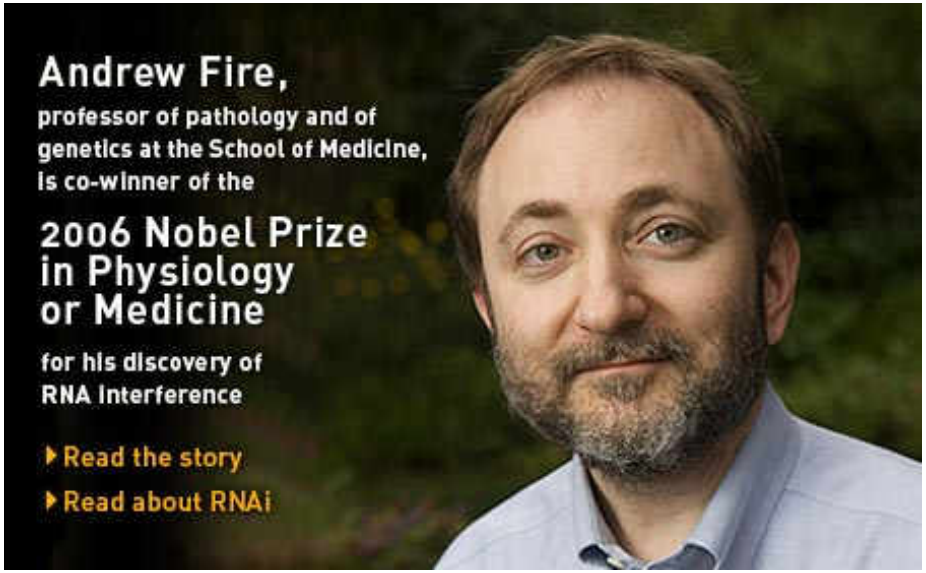

That moment when you remove an unwanted, freeloading house guest...
someecards
user card


Number of Publications
Number of Researchers
Available information
HLB cure
Years

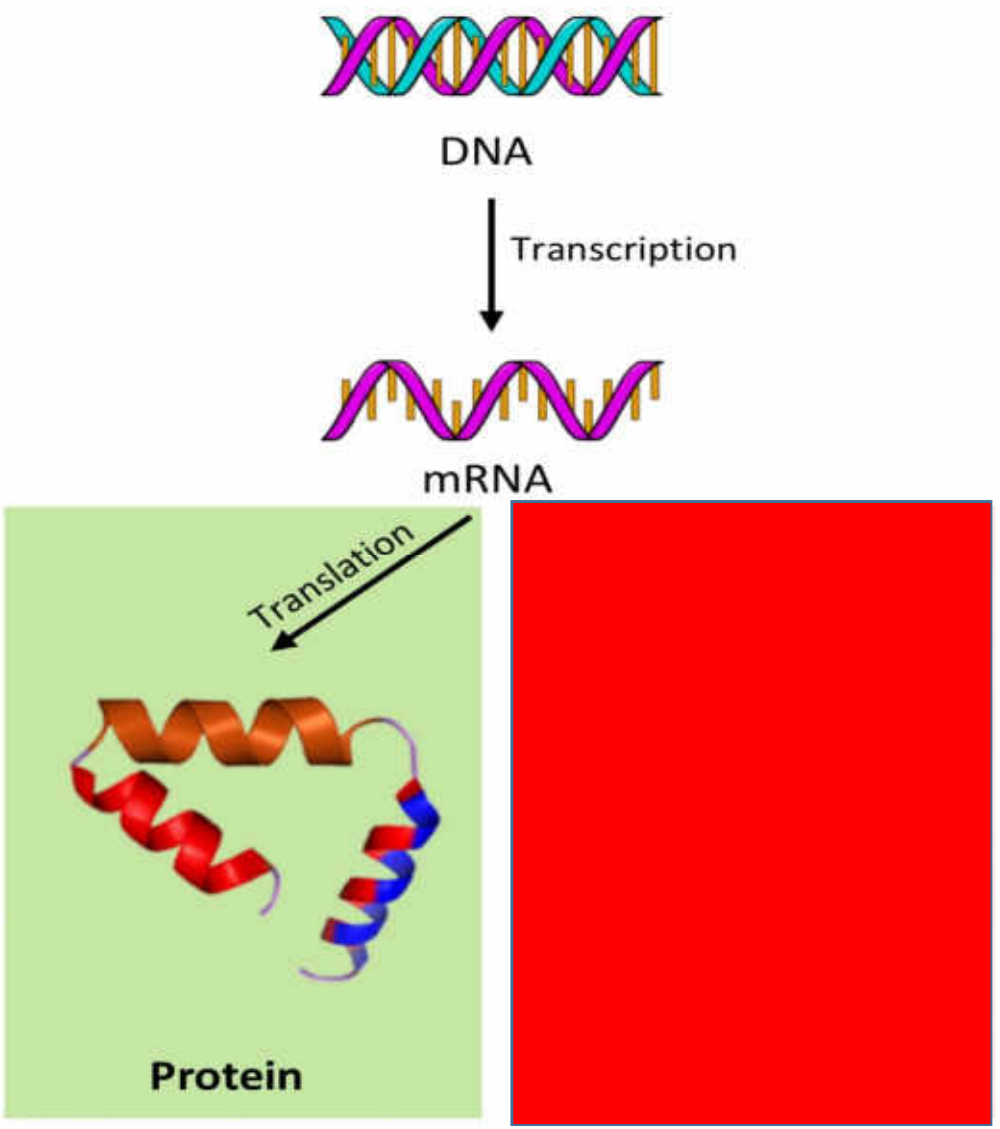
Thinking outside the box

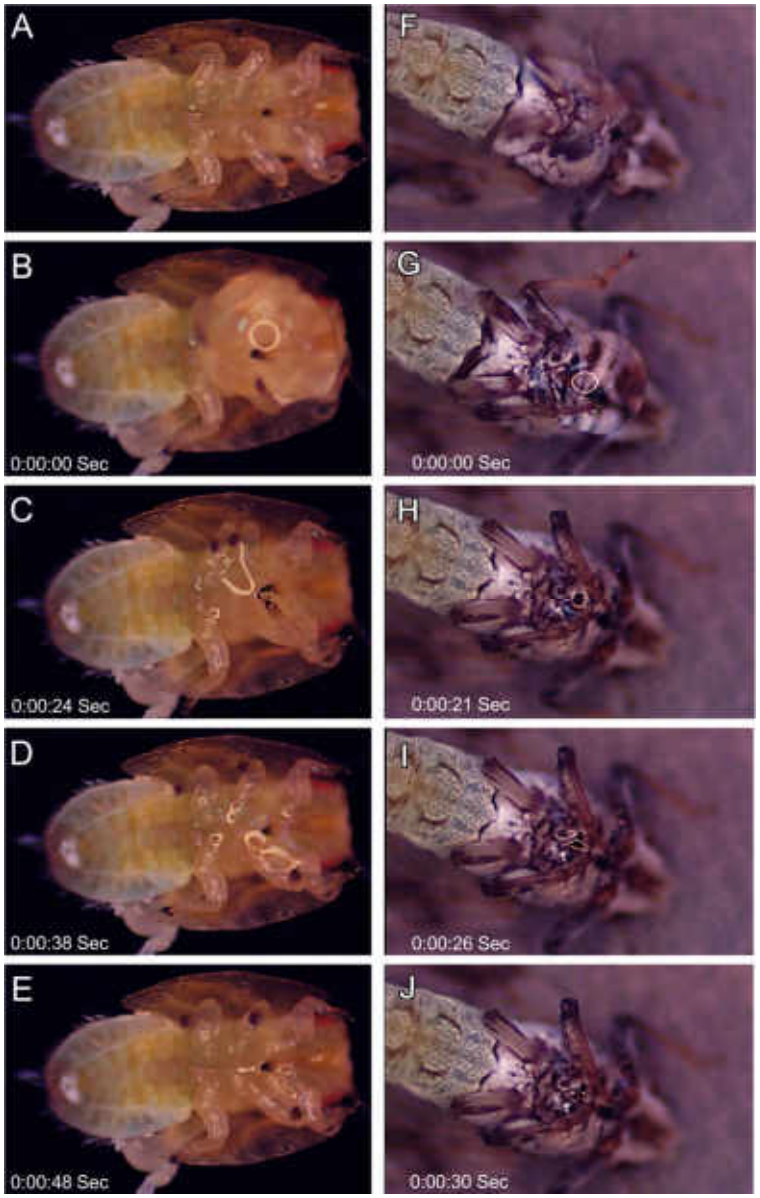
ACP is the true enemy


UNDERSTANDING
RNAi
RNAi, or "RNA Interference," is a natural process that occurs in the cells of plants, animals, and people.
All living things – like this plant – are made up of cells, the basic units of life.
Cytoplasm
Nucleus
Inside the nucleus of each cell is a detailed genetic blueprint, encoded in DNA...
DNA
... which is transcribed (copied) into messenger RNA (mRNA) ...
mRNA
...which gets translated by the cell's machinery to make a specific protein.
Protein
Proteins are the building blocks of tissues and they carry out many essential biological functions. In some cases, decreasing the production of specific proteins can be beneficial. RNAi is a natural process that works like a "dimmer switch" to dial down the level of a protein. It likely evolved to protect cells from viruses.
HOW DOES RNAi WORK?
1 It begins when a form of RNA made of two strands (double-stranded RNA, or dsRNA) is introduced into the cell, for example by a virus, or produced in the cell.
2 When a cell "sees" dsRNA, it activates structures that work like scissors to cut it up.
3 Next, other structures attach to these small pieces of RNA and turn them back into single-stranded RNA.
4 These structures then bind to mRNA with a matching code.
5 As a result, production of the protein encoded by that mRNA is prevented.
Protein
When we know the gene that encodes a certain protein, we can use RNAi to target that protein and dial it down in a highly specific way. In agriculture, for example, this can potentially impact the production of proteins responsible for the development of a disease or essential for a pest's survival, thus protecting plants from such disease or pest infestations.



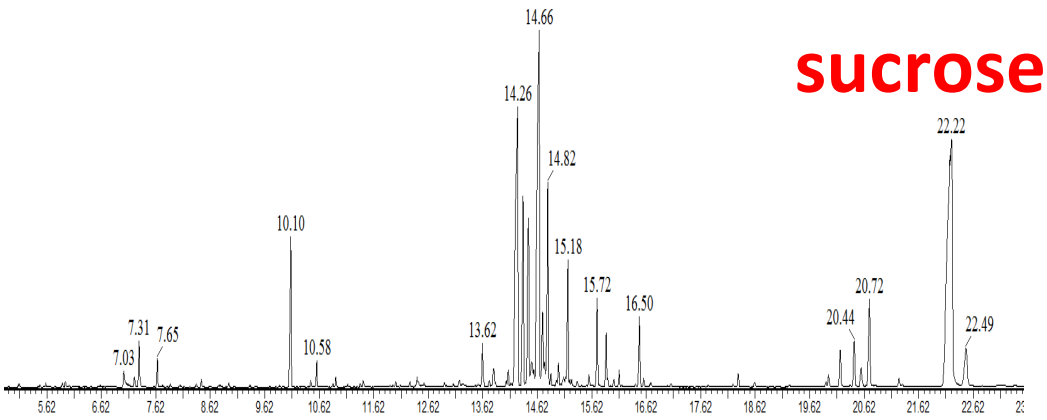
RNA interference
Reduction of a gene product




A
B
0:00:00 Sec
C
0:00:24 Sec
D
0:00:38 Sec
E
0:00:48 Sec
F
G
0:00:00 Sec
H
0:00:21 Sec
I
0:00:26 Sec
J
0:00:30 Sec

Screening for target genes

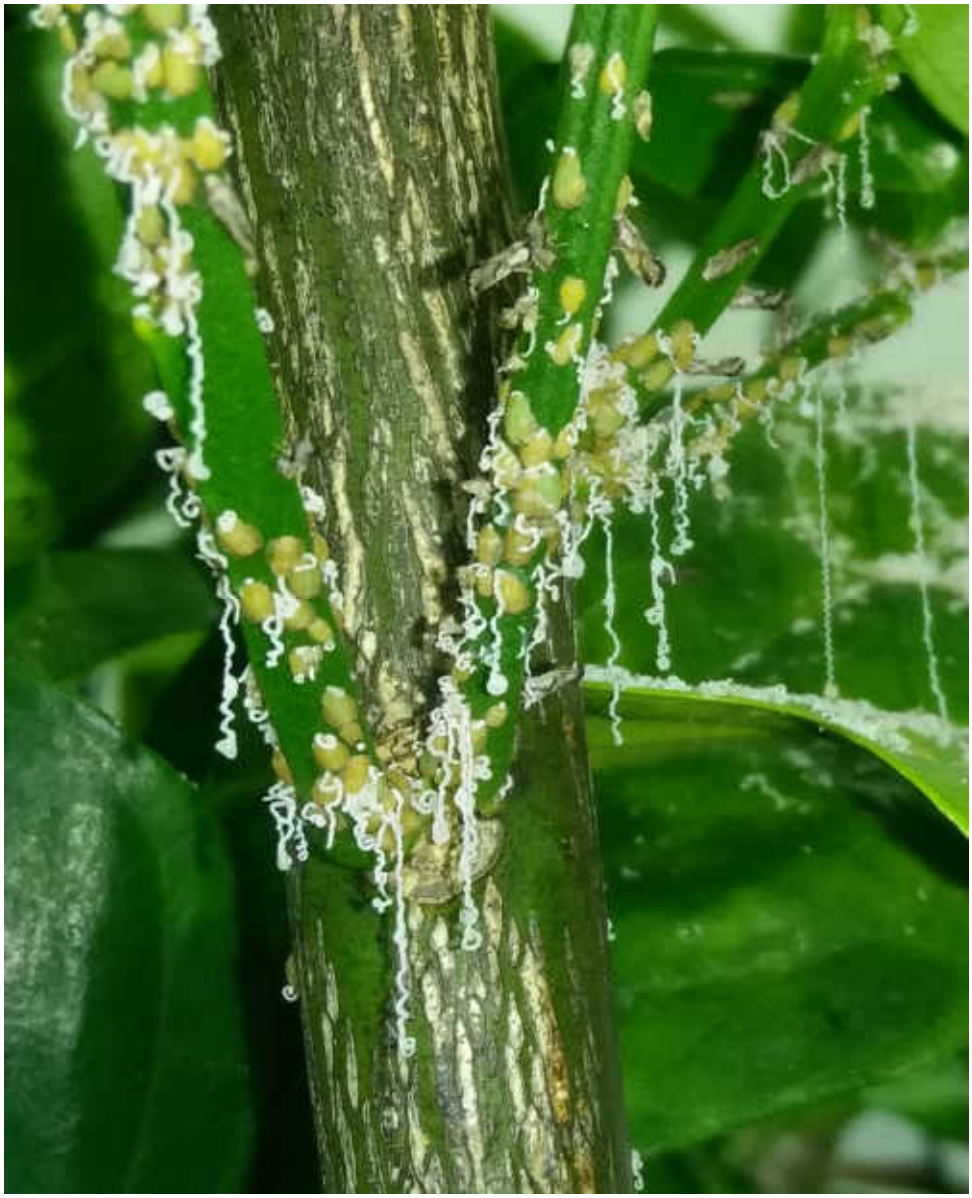
1: Food coma

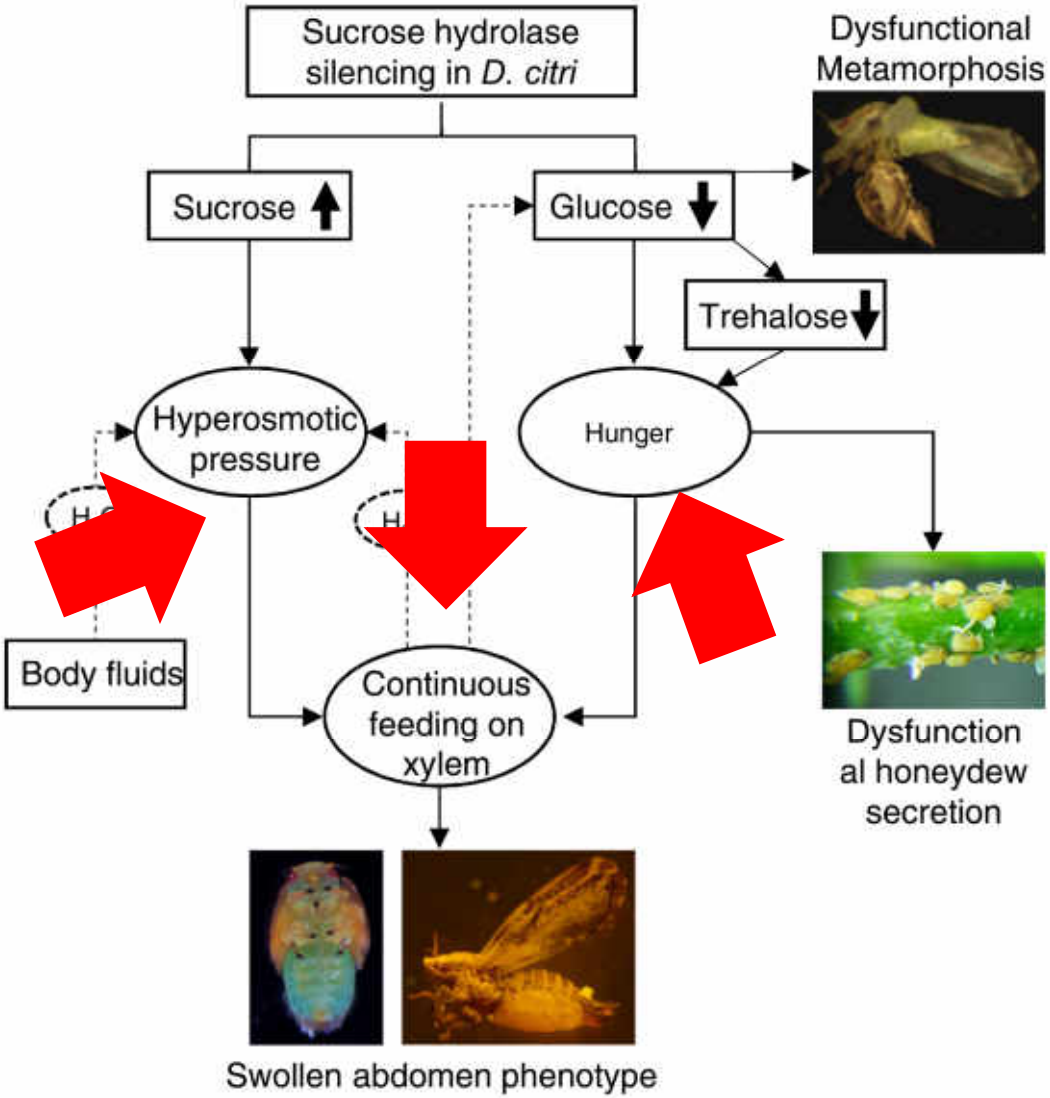


sucrose

Osmotic potential:

1) Hydrolysis of sucrose;
2) transglycosidation of sucrose into oligosaccharides (honeydew)
3) dilution by water by feeding on xylem sap




Sucrose hydrolase silencing in *D. citri*
Dysfunctional Metamorphosis
Sucrose
Glucose
Trehalose
Hyperosmotic pressure
Hunger
Body fluids
Continuous feeding on xylem
Dysfunctional honeydew secretion
Swollen abdomen phenotype

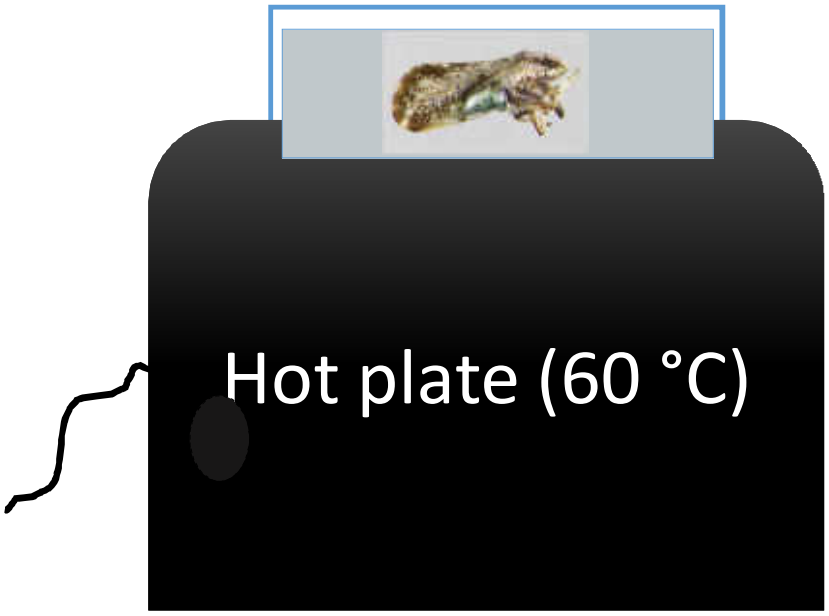
Screening for target genes

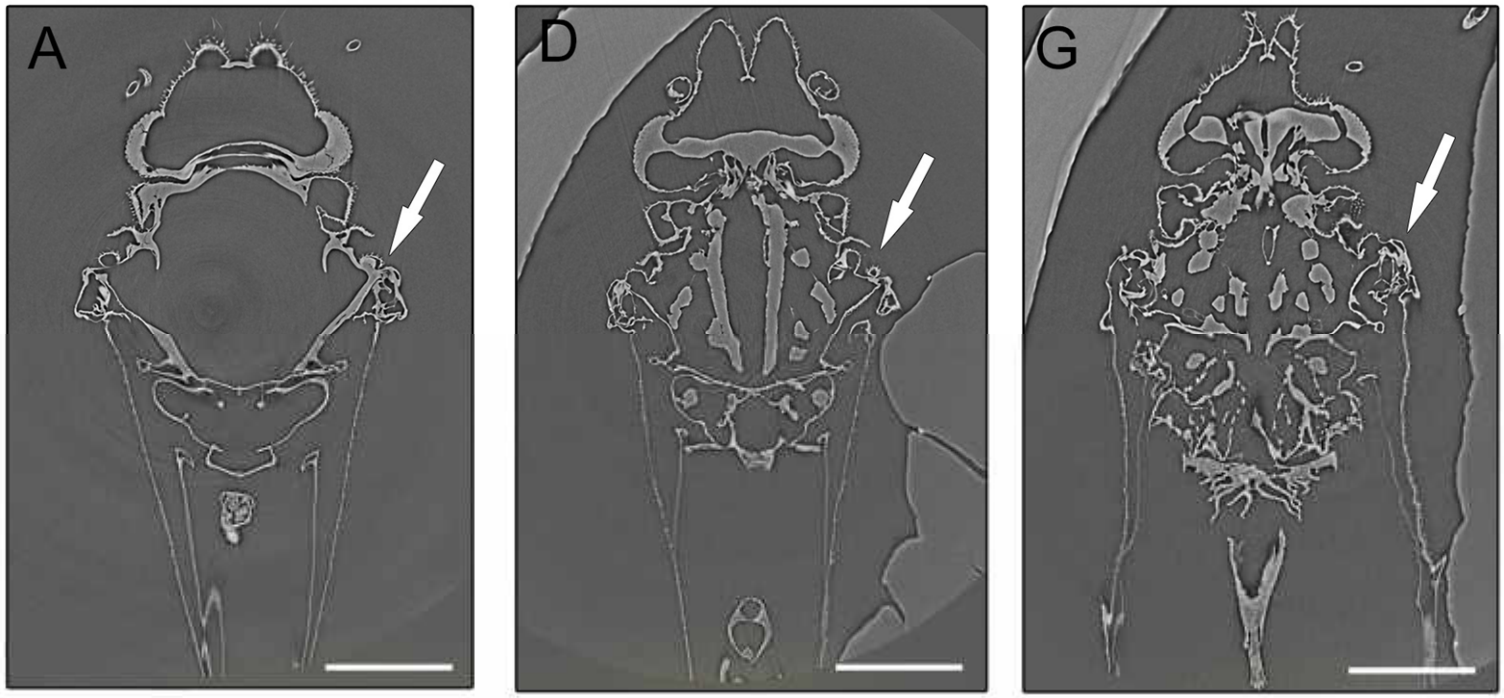
2: Fly the coop

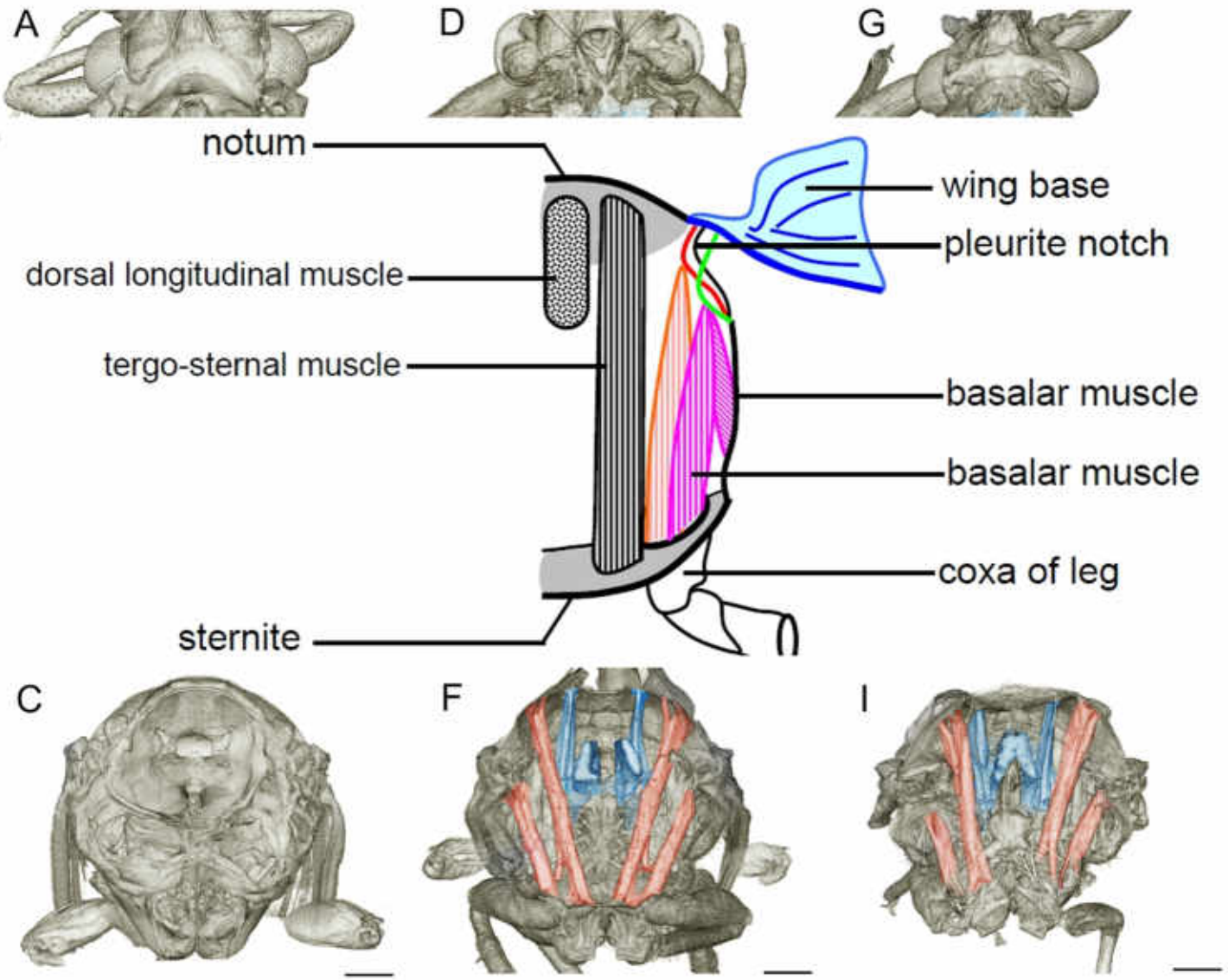

C
F
I
D
G
J
E
H
K

Screening for target genes

3: Lazy-bones

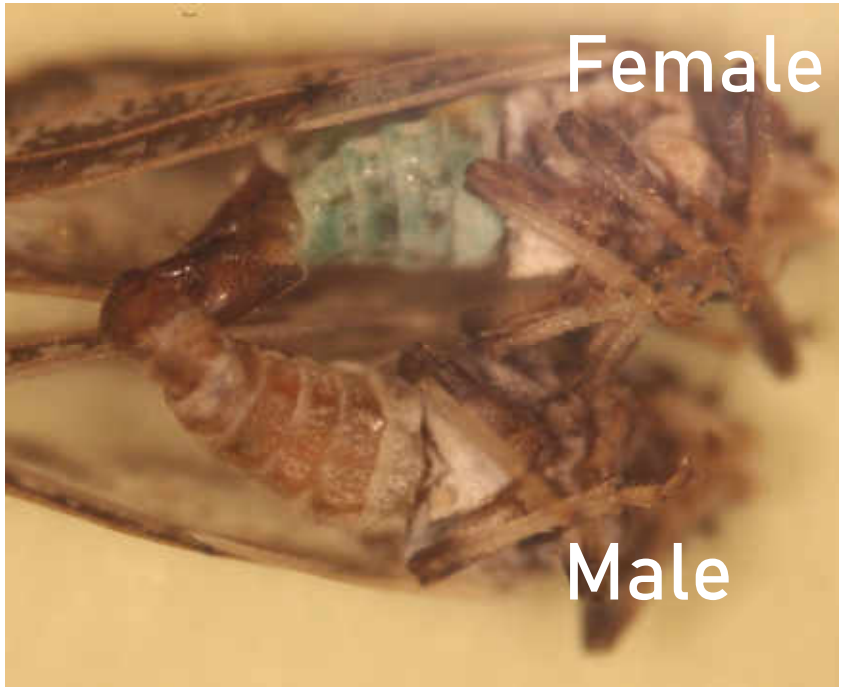


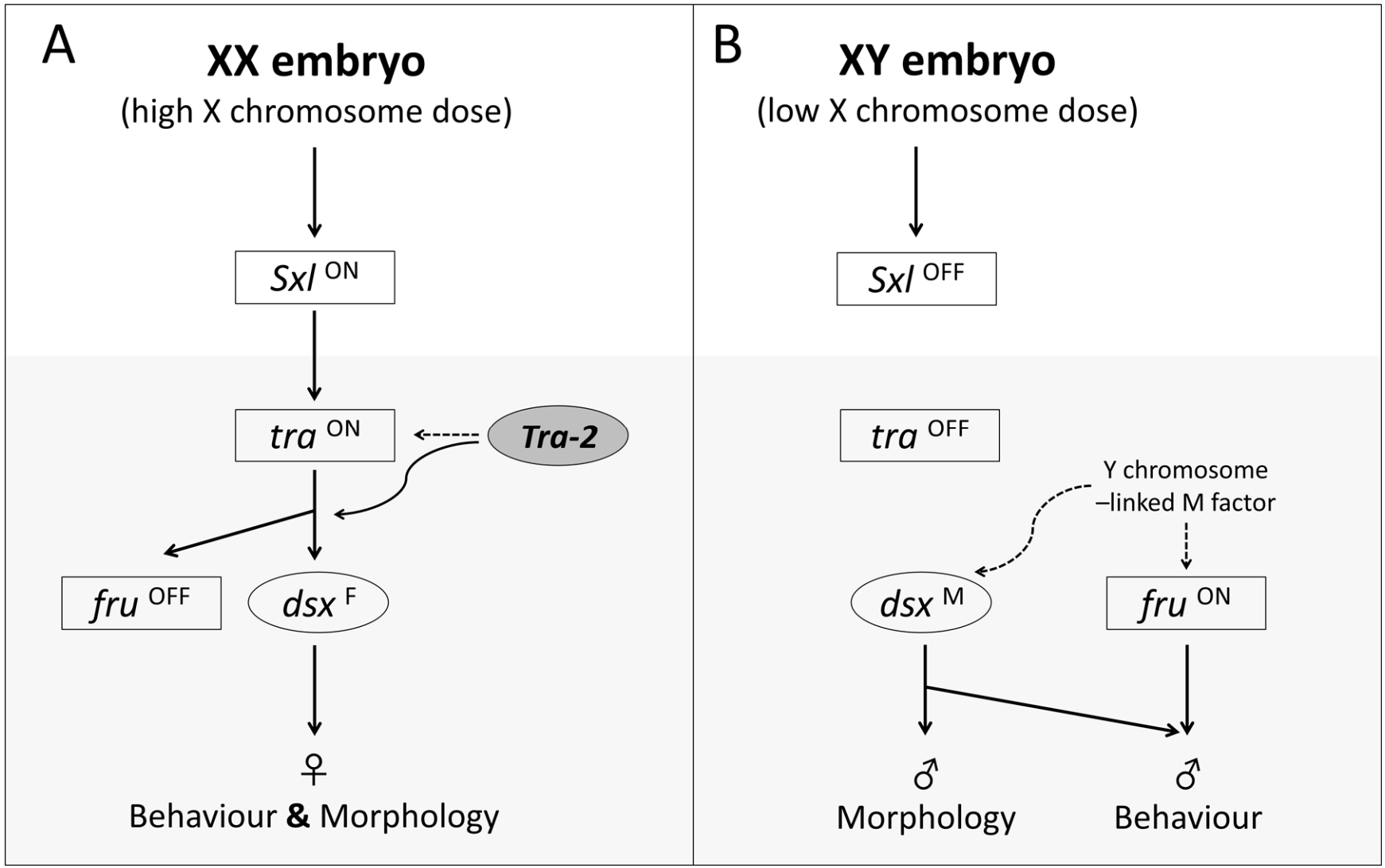

A
D
G


A
D
G
notum
wing base
pleurite notch
dorsal longitudinal muscle
tergo-sternal muscle
basalar muscle
basalar muscle
coxa of leg
sternite
C
F
I

Screening for target genes

4: Island of lost men




A
XX embryo
(high X chromosome dose)
Sxl ON
tra ON
Tra-2
fru OFF
dsx F
♀
Behaviour & Morphology
B
XY embryo
(low X chromosome dose)
Sxl OFF
tra OFF
Y chromosome
–linked M factor
dsx M
fru ON
♂
♂
Morphology
Behaviour

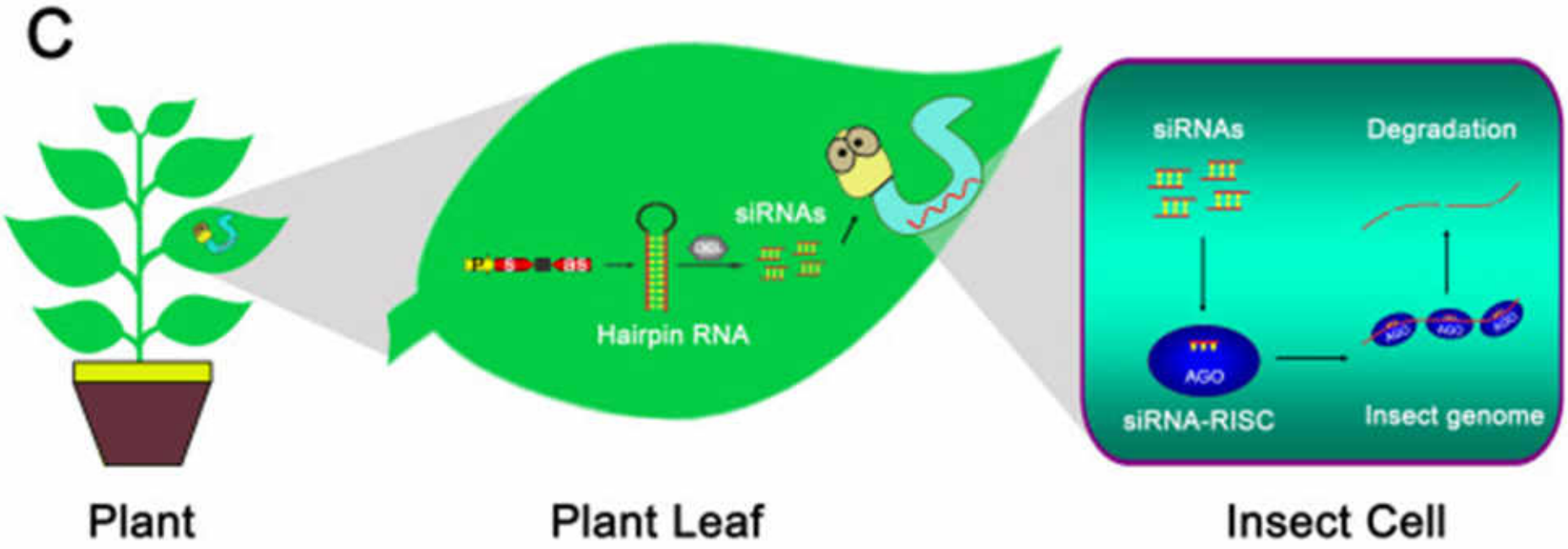
Best gene candidates

- Significantly affect survival, fertility, transmission of HLB bacteria,…….
- Asian Citrus Psyllid specific
- RNAi of a gene does not require its entire sequence


URGENT

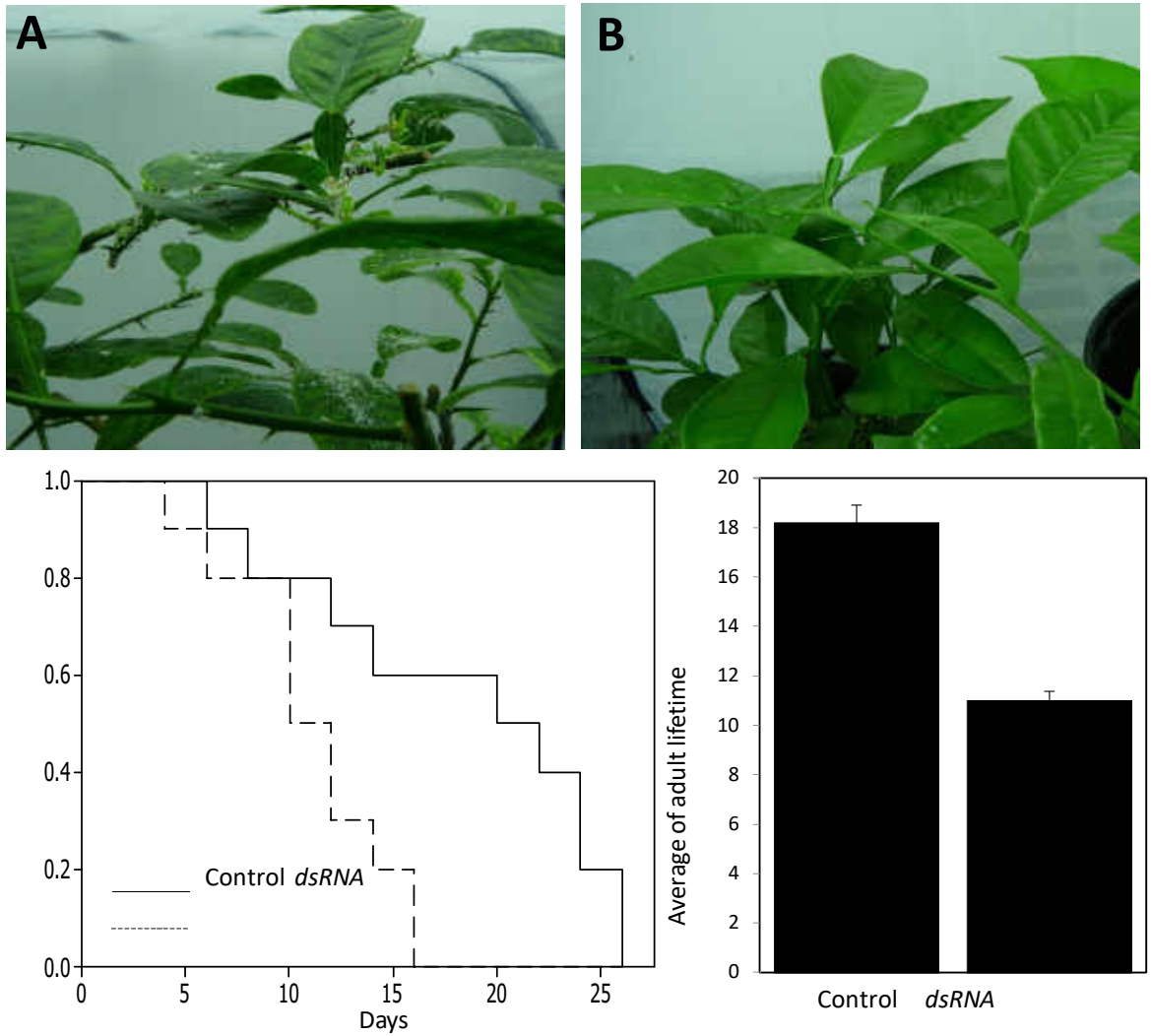

Download from
Dreamstime.com

1-Virus induced gene silencing using CTV

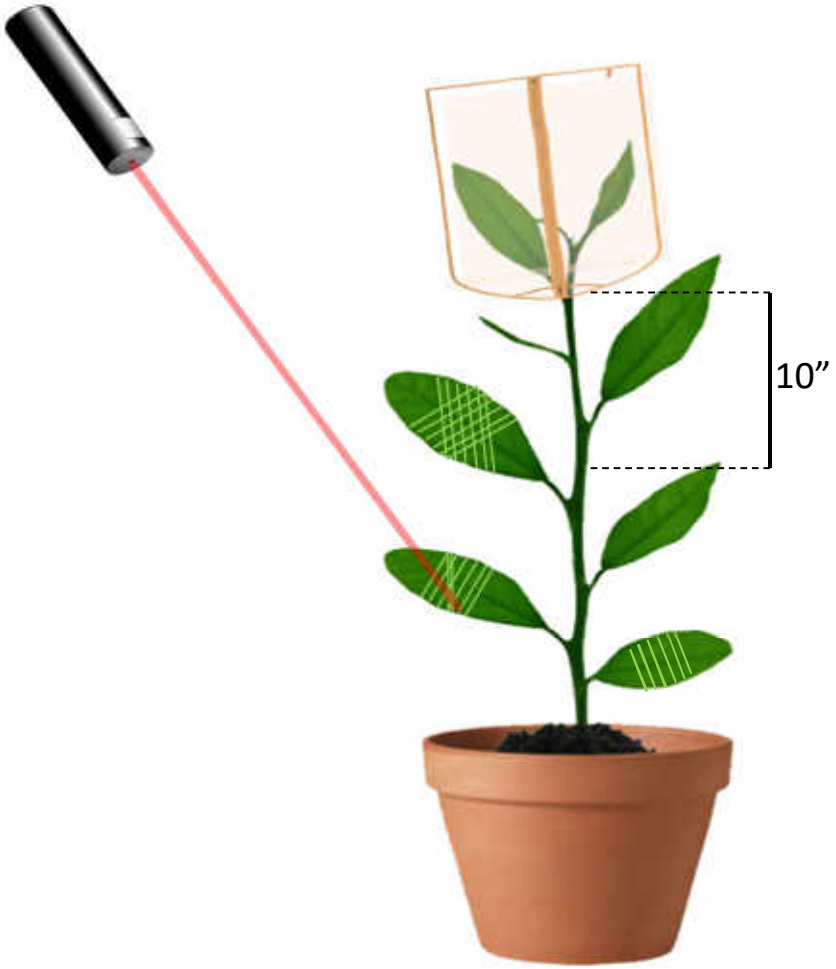


Virus induced gene silencing

CTV

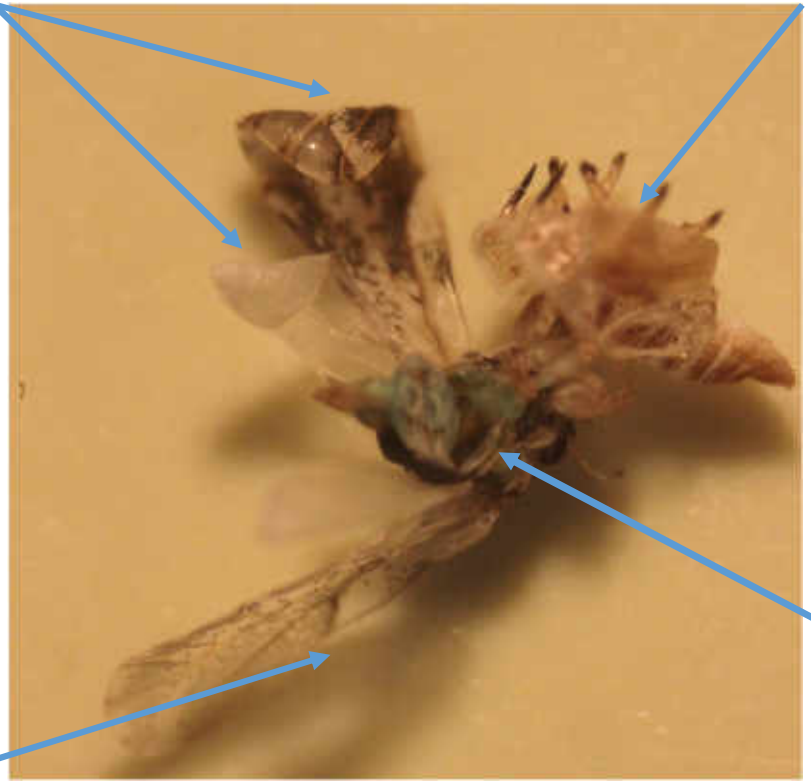


2- Laser delivery of dsRNA



Curled wings
(cup shaped)

Incomplete
molting



Stunted
malformed body

Stretched wing

3- Gene-editing using CRISPR-Cas9

Conclusion

- RNA interference is new technology where we can silence important genes in Asian citrus psyllid causing mortality or inability to fly, and/or increase pesticide susceptibility.
- RNAi is a promising and potential tool to control Asian citrus psyllid but is not ready yet for application in the field.
- Combinations of RNAi and other methods such as pesticide application or Bt-toxin could offer a very efficient control strategy.

THANK YOU