Juvenile Hormone Sensitivity of a *Drosophila melanogaster* Enhancer Region on the *Foraging* Gene

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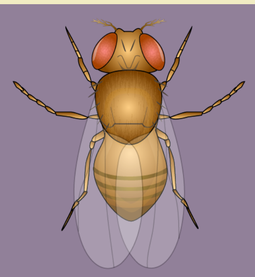


ABSTRACT

- The main objectives of this experiment were to determine if:
  - (1) juvenile hormone affects transcription
  - (2) if juvenile hormone regulated enhancers are also regulated by ecdysone.
  - (3) *foraging* is a juvenile hormone target gene
- Results indicate that the enhancer regulates transcription in a temporally, spatially, sex specific, environmentally and ecdysone receptor dependent manner.
- LacZ expression was found in ecdysone regulated locations such as the eye disc morphogenic furrow, imaginal discs, and optic lobes.
- Juvenile hormone INCREASES the transcription of LacZ in males and females.
- Ecdysone receptor (EcR) ***INHIBITS*** juvenile hormone sensitivity among both males and females.
- Foraging enhancer is BOTH JH and ecdysone regulated.
- Results support the theory that (1) foraging is a juvenile hormone target gene, (2) the juvenile hormone regulated enhancer is also regulated by ecdysone, (3) juvenile hormone INCREASES transcription of LacZ, (4) EcR binding decreases JH sensitivity.

BACKGROUND: Juvenile Hormone and Ecdysone

- The juvenile hormone and ecdysone are essential hormones for insect development.
- *JUVENILE HORMONE*: delays early metamorphosis and regulates the insect's physiological development.
- *ECDYSONE*: promotes growth, and larval molts in the presence of the juvenile hormone.
- The molecular pathways of the JH response are unknown.
- Scientists speculate that there are hundreds of JH target genes. However, only ten have been confirmed. (Dubrovsky, et. al.,2014)

BACKGROUND: *Foraging* Gene

✧ Possible juvenile hormone target gene, the **FORAGING GENE**, affects:
- Metabolite
- Food-leaving behavior
- Gene expression levels in response to food deprivation

✧ Responsible for 2 behavioral morphs in *Drosophila melanogaster*:
(a) rovers (b) sitters

✧ Juvenile hormone expression is associated with increased *foraging* expression in other insects:

- *Honey bee*: high expression of *for* shifts the role of the honey bee from nursing to foraging for pollen/nectar (Kent CF, et. al., 2009)
- *Ants*: high expression of *for* present in harvester ants

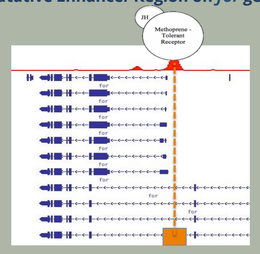
HYPOTHESES

- *HYPOTHESIS 1*: LacZ expression will change among methoprene treated and ethanol treated W3L, which indicates juvenile hormone sensitivity of the enhancer region on the foraging gene.
- *HYPOTHESIS 2*: LacZ expression in mutants will be greater than in the full enhancer flies; this will prove JH regulated enhancers are also ecdysone regulated.

HOW MIGHT JH AND *FOR* GENE BE RELATED?

1. Methoprene-tolerant binding sites are on the *for* gene.
2. Juvenile hormone controls the *for* gene in honey bees.
3. Both are heavily involved in the behavioral and nutritional status of flies.

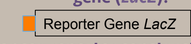
Putative Enhancer Region on *for* gene:



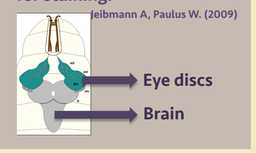
METHODOLOGY

JH Sensitivity of the Enhancer

1. *for* gene enhancer attached to a reporter gene (*LacZ*).



2. Enhancer-reporter construct inserted into control and mutant flies.
3. Third instar larvae were treated either with ethanol, or JH mimic: methoprene; they were then dissected and stained.
4. The brain and eye discs were examined for staining.



Weibmann A, Paulus W. (2009)

DISCUSSION

OPTIC LOBES

- EcR INHIBITS LacZ in the optic lobes.
  - The WILDTYPE flies had no LacZ expression, but the mutant flies without EcR exhibited strong expression in the optic lobe.
- JH further reduces the expression of LacZ in the mutant larvae.
- The optic lobe expression is sensitive to BOTH EcR and JH.

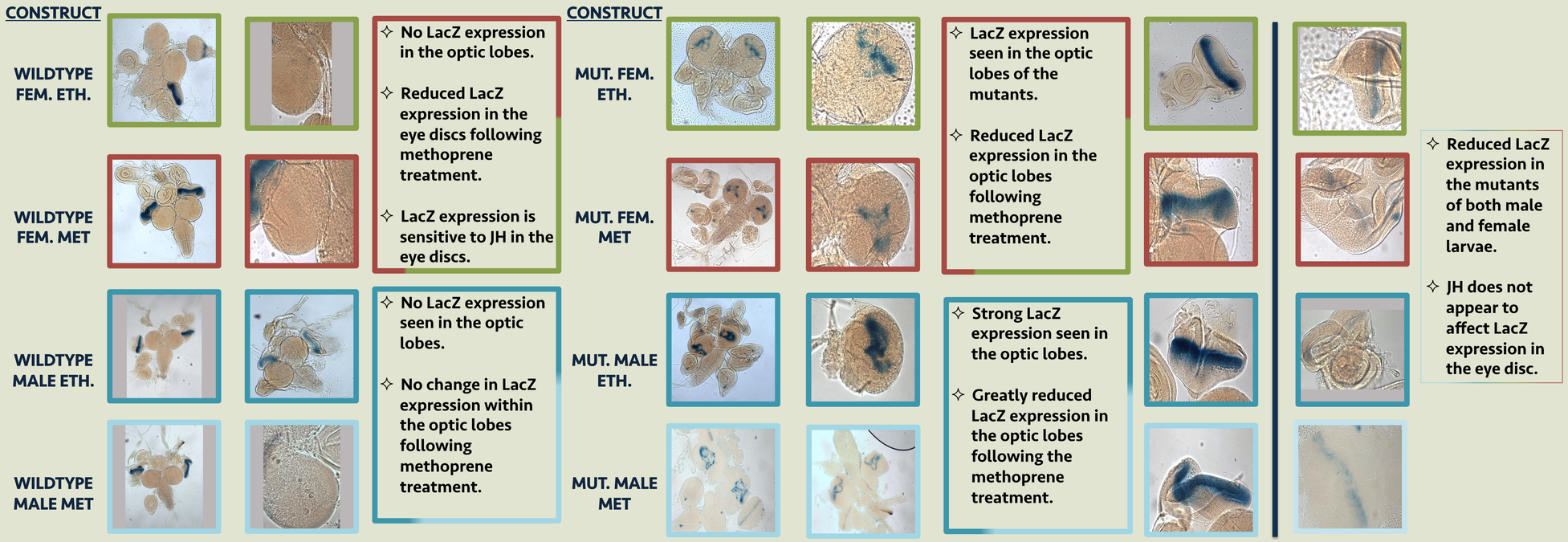
EYE DISCS

- EcR is required for normal LacZ expression.
- JH inhibits LacZ expression in the eye discs.
- EcR is *not* required for JH sensitive response seen in the larvae.

FUTURE DIRECTIONS

- Flies without EcR entirely will be treated and stained to determine the role of EcR in juvenile hormone regulated enhancers.
  - We expect absence of EcR will INCREASE juvenile hormone sensitivity.
- *Foraging* gene expression will be examined in tissues that had the most LacZ staining (enhancer activity).
  - This will be done to confirm the target gene activity.
- Test for JH sensitivity in Methoprene Tolerant mutants:
  - Methoprene Tolerant: JH receptor
  - Methoprene Tolerant mutants have a mutated JH receptor.
  - Will allow us to confirm whether JH sensitivity is dependent on JH receptors.

RESULTS



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