Hammarlund Take home Question 2016

This exam discusses the following paper: Genetics 121: 101-117 (January, 1989).

Early development relies on maternally contributed mRNAs, since the zygotic genome is inactive. To study this process, Trudi Schupbach and Eric Wieschaus decided to screen for **recessive mutations that result in female sterility**. By definition, these 'maternal effect' mutations will have the following properties: 1) if the mother is heterozygous, all her offspring will be viable (even when the offspring are homozygous mutant). 2) If the mother is homozygous mutant, there will be no viable progeny (even when the potential progeny is not homozygous mutant—for instance, if its father is wild type).

Read the introduction and the first part of the methods section. Two screen strategies are described. The first is exactly like the embryonic lethal screen we studied in the discussion sections, except the phenotype they are looking for is different. Instead of looking for embryonic lethals (by looking for vials with no white-eyed flies), they need vials that do have white-eyed flies and so are homozygous for the mutagenized chromosome II. For each vial, they remove these white-eyed flies and test them for fertility.

Once you understand that screen, please consider Figure 1 and the corresponding part of the Methods section. This screen is more complicated and is designed so that they don't have to select white-eyed flies—rather, all the flies in the vial can be tested en masse.

Please note that CyO.513, in addition to the characteristics described in the text, is also homozygous lethal (just like the original CyO). Also, the Latin term 'inter se' means 'among themselves', and can be taken to mean that all the flies in the vial are allowed to mate together. Finally, there is a strange flaw at the bottom of the figure: in the line beginning 'F3 survivors', the 'female' symbols are misprinted.

1. Redraw (neatly) Figure 1, but in more detail, showing all the genotypes at each step. For the F3 generation, please use a Punnett square. Also indicate phenotypes and how this information is used in the next step. Make sure to describe this very clearly. Your goal is to demonstrate complete understanding of the screen.

2. Which matings do you think were done with single animals (and of what gender), and which with many animals? Why?

3. Critically evaluate this screen. What could one expect to miss, and what are the weaknesses? What could one expect to learn, and what are the benefits? Try to answer fully.

4. If Trudi and Eric had had access to all our modern tools, do you think they still would have chosen to do a forward genetic screen to address the question of maternal contributions to development, or can you suggest a better idea? Defend your answer.