Prevalence of Foodborne Pathogens in Flies Living Near a Landfill

Conducted by the University of Arizona Cooperative Extension
In collaboration with Yuma County Pest Abatement District
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Introduction

Fly populations in the Yuma Mesa area have increased exponentially in recent years. Flies are known vectors of enteric foodborne pathogens, including *Salmonella* and *E. coli* (Nazni et al. 2005; Butler et al. 2010). Moreover, flies can transfer these pathogens to leafy greens, the heart of Yuma's agricultural success (Talley et al. 2009). Since the South Yuma County Landfill and other agricultural operations handling Class B biosolids are located in close proximity to date and citrus groves, there is concern that the massive number of flies in the area is not only a nuisance, but a hazard to field workers and potentially to the crops.

We conducted a study to determine if fly populations near the South Yuma County Landfill carry enteric foodborne pathogens that may be transmitted directly to humans and/or contaminate local produce. We also collected flies from sites where Class B biosolids from human waste are used in agricultural fields in order to determine if those flies also carry enteric foodborne pathogens.

Materials and Methods

We conducted three fly trapping events: March 16, March 25, and May 18, 2015 (Table 1). During the March trapping events, we set a total of 25 traps each time: 5 traps along the fenceline between the landfill and the date grove, 5 traps at 0.5km into the date grove, 5 traps at 1 km into the date grove, 5 traps at a nearby school that experienced high numbers of flies (6.5 km away from the landfill), and 5 traps at a lettuce disposal site (4.5 km away from the landfill). Since there were no lettuce disposal sites in May (lettuce season had ended), we chose to test two sites with biosolids: we set 5 traps near a field that had biosolids disked in and 5 traps at a biosolid pile.

Table 1. Number of traps set by location and date

Trap sites	March 16	March 25	May 18
Fenceline between date grove and landfill	5 traps	5 traps	5 traps
0.5 km into date grove	5 traps	5 traps	5 traps
1.0 km into date grove	5 traps	5 traps	5 traps
School	5 traps	5 traps	5 traps
Lettuce disposal site 1	5 traps	---	---
Lettuce disposal site 2	---	5 traps	---
Biosolid field	---	---	5 traps
Biosolid pile	---	---	5 traps
TOTAL	**25 traps**	**25 traps**	**30 traps**

The traps we used were originally designed to catch eye gnats, but were found by the Yuma County Pest Abatement District to be very effective at trapping flies as well. Two plastic jars without lids were assembled top to top using a black PVC collar in the middle. The PVC collar is perforated with several holes for flies to enter. When positioned so one jar is upright and the other is upside down, the bottom jar holds fly bait (fermented egg and water) and is covered with a screen so the flies do not fall into it when they enter the trap. A small plastic cup with a hole is inside the top jar. When the flies enter the trap, they fly upwards through the hole into the jar and cannot escape. Jars and cups are made from new, food grade materials, and the collar, screen and hook are all soaked for 24hrs in bleach solution. Prior to setting the traps, each trap is weighed, and the total weight of the flies collected is recorded when the traps are retrieved from the field.

On the morning of each trap date, we set traps at 0800 h. On the first trap date, we collected the fly traps at 1200 h. One the second trap date, we collected traps at 1400 h. On the final trap date, we collected flies 24 hours after the traps were deployed because at that time of year, high temperatures decrease fly activity so we wanted to maximize our chances of catching flies.

Once collected, the traps were disassembled, and each jar containing flies was capped and transported to the lab. The flies were then weighed and placed in the refrigerator for 1 h to reduce fly activity. Once removed from the refrigerator, flies from each trap were placed in individual zipper locking bags (one trap per bag). A rolling pin was used to crush the flies so both their internal and external anatomy could be tested for pathogens. Tryptic soy agar broth was then added to each bag and flies were placed in the incubator for enrichment. After 24 hours, each sample was subjected to immunomagnetic separation to isolate the specific pathogens of interest, and the samples were cultured on selective media. We then conducted PCR on positive cultures to confirm the presence of the pathogens.

Results

Figure 1 shows data for all three trapping events combined. *E. coli* O157 was not found in any of our samples, but we did find other forms of shiga toxin-producing *E. coli* (non-O157 STEC). In fact, fly traps at every site tested positive for non-O157 STEC, except the two sites with Class B biosolids. *Salmonella* was also found at every site and during every trapping event, with the one exception of the lettuce disposal sites, which never tested positive for *Salmonella*. It is interesting to note that although the fly traps at locations with Class B biosolids did not test positive for *E. coli* O157 or non-O157 STEC, 100% of those traps tested positive for *Salmonella*.

Fig. 1

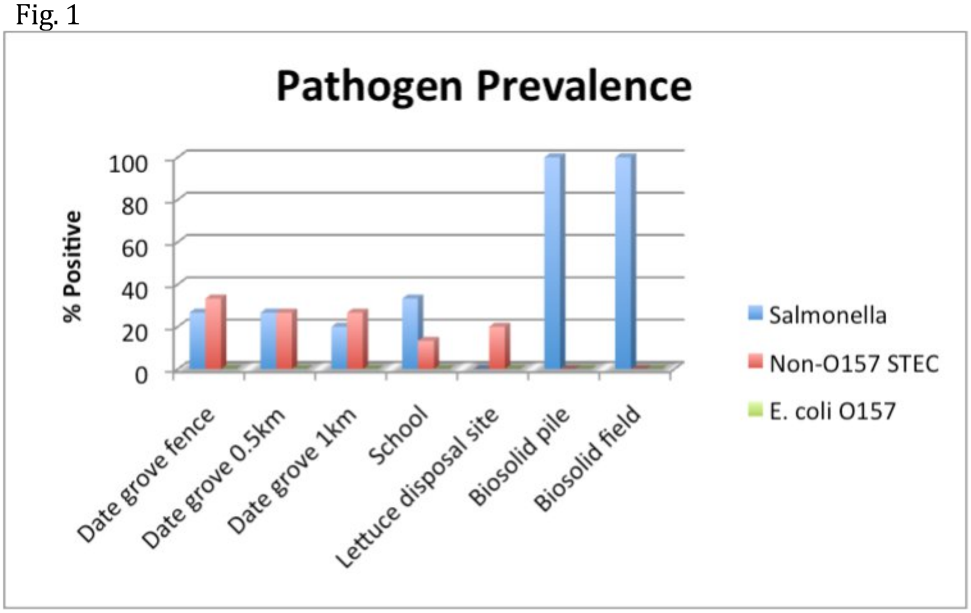


Figure 2 shows that flies tested positive for *Salmonella* at every trapping location, except at the lettuce disposal site. There is no clear trend in the prevalence of *Salmonella* in relation to the landfill. However, there is always *Salmonella* present in the area of the date grove. Flies trapped at the date grove tested positive for *Salmonella* during every trapping event, and the prevalence of *Salmonella* contamination varied among the three trapping dates from 20% to as high as 60%. The flies collected from locations with Class B biosolids were positive for *Salmonella* 100% of the time.

Fig. 2

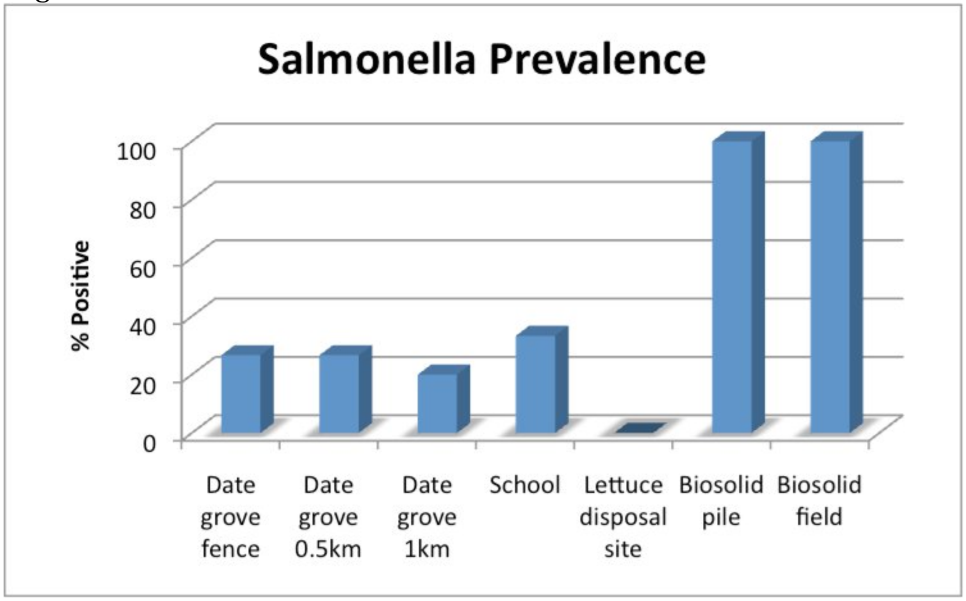
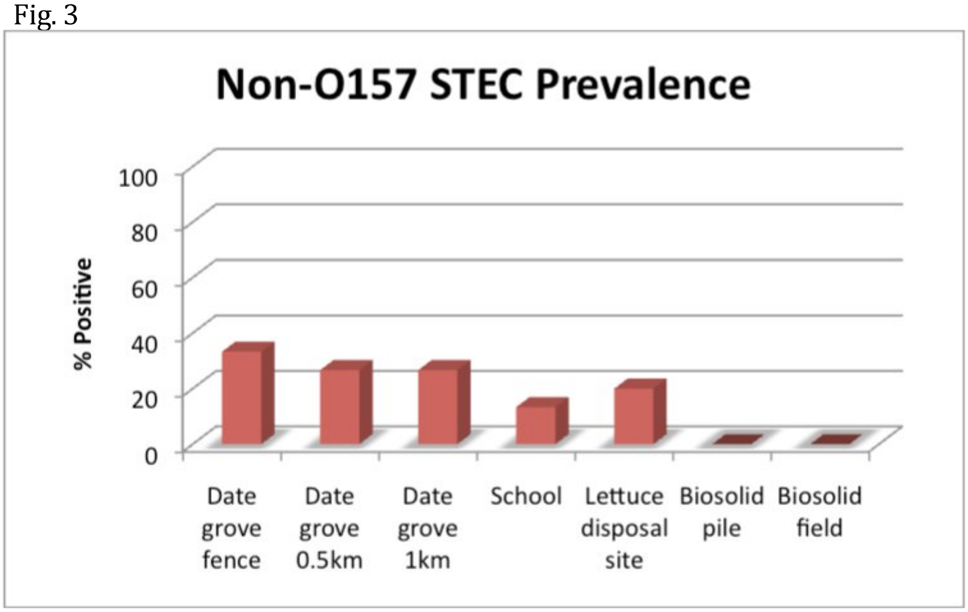


Figure 3 shows a trend in the prevalence of non-O157 STEC at the date grove with the highest prevalence closest to the landfill, and lower prevalence with distance from the landfill, even as far as the school. In fact, during our earliest sampling in spring, 80% of the traps set at each of the three locations in the date grove tested positive for non-O157 STEC. The lettuce disposal site also tested positive for non-O157 STEC. However, none of the flies collected from the locations with Class B biosolids tested positive for non-O157 STEC.

Fig. 3



Conclusions and recommendations

Flies are known vectors of foodborne pathogens. Our data indicate that *Salmonella* is present in the date grove, and there is a trend for higher prevalence of non-O157 STEC in flies located closer to the landfill versus those at further distances in the date grove. We have also established that flies living in and around areas of biosolids have a very high prevalence of *Salmonella*.

We recommend that the issues of fly abundance and fly contamination be addressed by both the appropriate regulatory authorities and the industries involved. Source reduction, whereby flies are denied the opportunity to reproduce in open human and agricultural waste, is preferred over widespread use of pesticides to control the fly populations. For example, liquid septage and Class B biosolids could be treated to render them less attractive to flies. Agricultural wastes, such as the waste stream from salad packing plants, should cease being dumped in the desert where they often times are left to rot. We recommend that salad waste be returned to source fields and incorporated with existing crop residue post-harvest. Alternatively, lettuce waste could be disposed of at the landfill, or de-watered and composted.

The handling in open fields of Class B biosolids, apparently a potent source of *Salmonella,* should be restricted to extremely remote areas with restricted public access, and beyond the flight range of vectors that could transport pathogens to fresh food crops directly consumed by humans (fresh vegetables, dates, citrus, etc), and to schools, businesses and residences. It is also suggested that Class B biosolids be tarped to reduce exposure to flies, that the on-site storage interval be reduced from the two years currently permitted to a few days, and that the material be completely covered when incorporated into agricultural land. The current method of disking does not adequately incorporate the biosolids into the soil, leaving much of it exposed to flies. Exposure of biosolids to flies could be minimized if the material were liquified and injected underground by shank or plowed under by moldboard plough.

Similar to Yuma, Western Australia experienced a drastic increase in flies over the last decade that they attribute, at least in part, to the agricultural use of biosolids (Pritchard et al. 2010). They found that there were a number of effective ways to reduce these fly populations by preventing them from breeding. One way was to construct a centralized biosolids storage facility that is completely vector-proof. Research showed that biosolids stored at this facility for 30 days did not serve as fly breeding material after they were spread on agricultural lands. Another way they reduced fly breeding in biosolids was to amend the biosolids with lime to reduce the moisture content. These methods could be considered for use in Yuma as well.

In summary, flies living near the landfill do carry *Salmonella* and non-O157 STEC, and flies living in and around areas treated with or storing Class B biosolids carry *Salmonella*. We recommend that measures be taken to control fly populations in order to prevent human illness that could result from direct contact with the flies or from consuming unwashed produce contaminated by the flies.

References

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