

Electropenetrograph Comparison of Male vs. Female Planthopper Probing Activity



Alexis Coles and Astri Wayadande
Oklahoma State University



ABSTRACT

Female *Perigrinus maidis* planthoppers are larger than male planthoppers. We hypothesize that females feed more on maize than do male planthoppers. The probing behavior of male vs. female planthoppers was studied using Electropenetrography (EPG). This species produced at least eight distinct waveforms, including those that represented xylem and phloem ingestion. The male planthoppers made the same waveform patterns as the females. Analysis of total probing duration, probe number, duration of xylem ingestion and duration of phloem ingestion shows that females consume more xylem and feed longer overall than do males, supporting our hypothesis that larger female bodies are supported by more feeding.

INTRODUCTION

- Planthoppers (Hemiptera: Delphacidae) feed from vascular tissue in plants (xylem and phloem)
- Female *Perigrinus maidis* planthoppers are 30-40% larger than males (Fig. 1B)
- We hypothesize that females eat more than males to support their larger size
- We tested the hypothesis by quantifying feeding behavior of males and females using electropenetrography, or EPG

METHODS

- *Perigrinus maidis* adults were reared in a growth chamber on corn
- Adult males and females were recorded while feeding on corn using an ACDC electropenetrograph (Wayadande et al. 2020)
- Each insect was tethered using 0.001" gold wire and silver glue (Figure 1 and 2)
- Each insect was recorded for six hours
- Eleven males and twelve females were recorded and measured
- EPG files were measured using Windaq (Dataq Inc) software
- Nine EPG parameters (Table 1) were measured and quantified
- T-Test statistic was applied to mean numbers of probes, probing duration, xylem ingestion and phloem ingestion

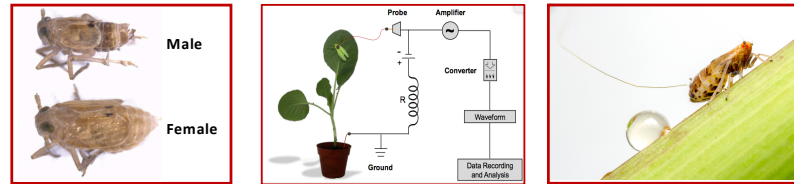


Figure 1A. Image of a male (top) and female (bottom) planthopper showing size difference (female is 30-40% larger).
Figure 1B. Schematic of the EPG circuit: Current travels through insect and through gold wire to the amplifier and converter to be displayed on the computer. Figure 1C. Gold wire attached to abdomen of adult *P. maidis* female. Note large excretion drop

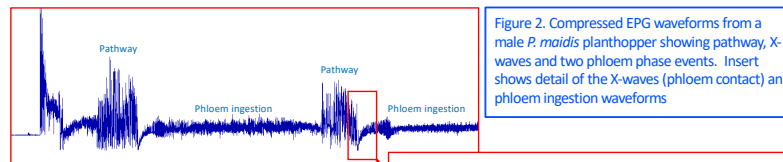


Figure 2. Compressed EPG waveforms from a male *P. maidis* planthopper showing pathway, X-waves and two phloem phase events. Insert shows detail of the X-waves (phloem contact) and phloem ingestion waveforms

Figure 3. Compressed EPG waveforms from a female *P. maidis* (below) planthopper showing xylem ingestion, pathway and phloem ingestion



Table 1. EPG waveform parameters measured and quantified for male vs female *Perigrinus maidis* planthoppers recorded while feeding on corn for six hours (21,600 sec). Four EPG parameter means were compared using t-tests; significance was determined at $p = 0.05$ level.

	Males (N = 11)	Females (N = 12)	Significant?
Mean Number of Probes	8.9	15.8	YES
Total Probing Duration	152,942 sec (N=11)	211,711 sec (N=12)	
Mean Probing Duration	13,903 sec/insect	17462 sec/insect	YES
Time to First Xylem Ingestion	5630 sec/insect	2675 sec/insect	
Total Xylem Ingestion	13,960 sec (N=11)	37,932 sec (N=12)	
Mean Xylem Ingestion	1269 sec/insect	3448 sec/insect	YES
Time to First Phloem Ingestion	4893 sec/insect	3570 sec/insect	
Total Phloem Ingestion	91,259 (N=11)	102,629 (N=12)	
Mean Phloem ingestion	8296 sec/insect	8552 sec/insect	NO

RESULTS

- Several distinctive waveforms were identified, including: Pathway (stylet movement into plant towards vascular bundle, X-waves (preparing vasculature for long term ingestion, xylem ingestion, and phloem ingestion (Figures 2 and 3)
- Pathway phase for this species was particularly lengthy, up to 60-90 minutes
- Both male and female *P. maidis* fed from both xylem and phloem (Figure 2 and 3)
- Females made more probes than males during the six hour recordings (Table 1)
- Females ingested significantly more xylem than males (Table 1)
- The amount of time spent in phloem ingestion was about the same for both genders (Table 1)
- It took males longer to reach both xylem or phloem than it took for females (Table 1)
- Overall, females spent significantly more time probing than did males (Table 1)

SUMMARY

- Eleven male and twelve female *P. maidis* planthoppers were compared using EPG
- Females fed significantly longer than males
- Females ingested more from phloem than did males, but this was not significantly different
- Thus, our hypothesis that females ingest more than males is supported by EPG data
- Higher levels of ingestion may explain, in part, sexual dimorphism observed for *Perigrinus maidis*

Acknowledgements

We thank Will Klobasa for help rearing planthoppers

References

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- Wayadande, A. E., Backus, B., Noden, and T. Ebert. 2020. Waveforms From Stylet Probing of the Mosquito *Aedes aegypti* (Diptera: Culicidae) Measured by AC-DC Electropenetrography. *J. Med. Entomol.*, 57: 353-368.