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Spring 4-14-2020

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Evaluating Larval Movement and Infestation of Soybean Gall Midge

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Introduction

Soybean gall midge (SGM) *Resseliella maxima* Gagné is a newly identified insect pest of soybean (Gagné et al 2019). As of August, 2019 a total of 92 counties across five midwestern states (Fig. 1) documented as infested. Heavily injured soybean fields show visible signs of dead or dying plants (Fig. 2a), causing significant economic losses for farmers.

Heavily injured soybean plants often die prematurely with several different larval stages (Fig. 2b) still feeding within the plant. Significant concern have been raised about the role of these larvae in infesting adjacent healthy plants.

To better understand the behavior and potential for larval infestation a study was designed to determine the ability of different larval instars to move on different surfaces, and their behavior in the soil. An additional study was conducted to determine the larval ability to infest soybean plant.

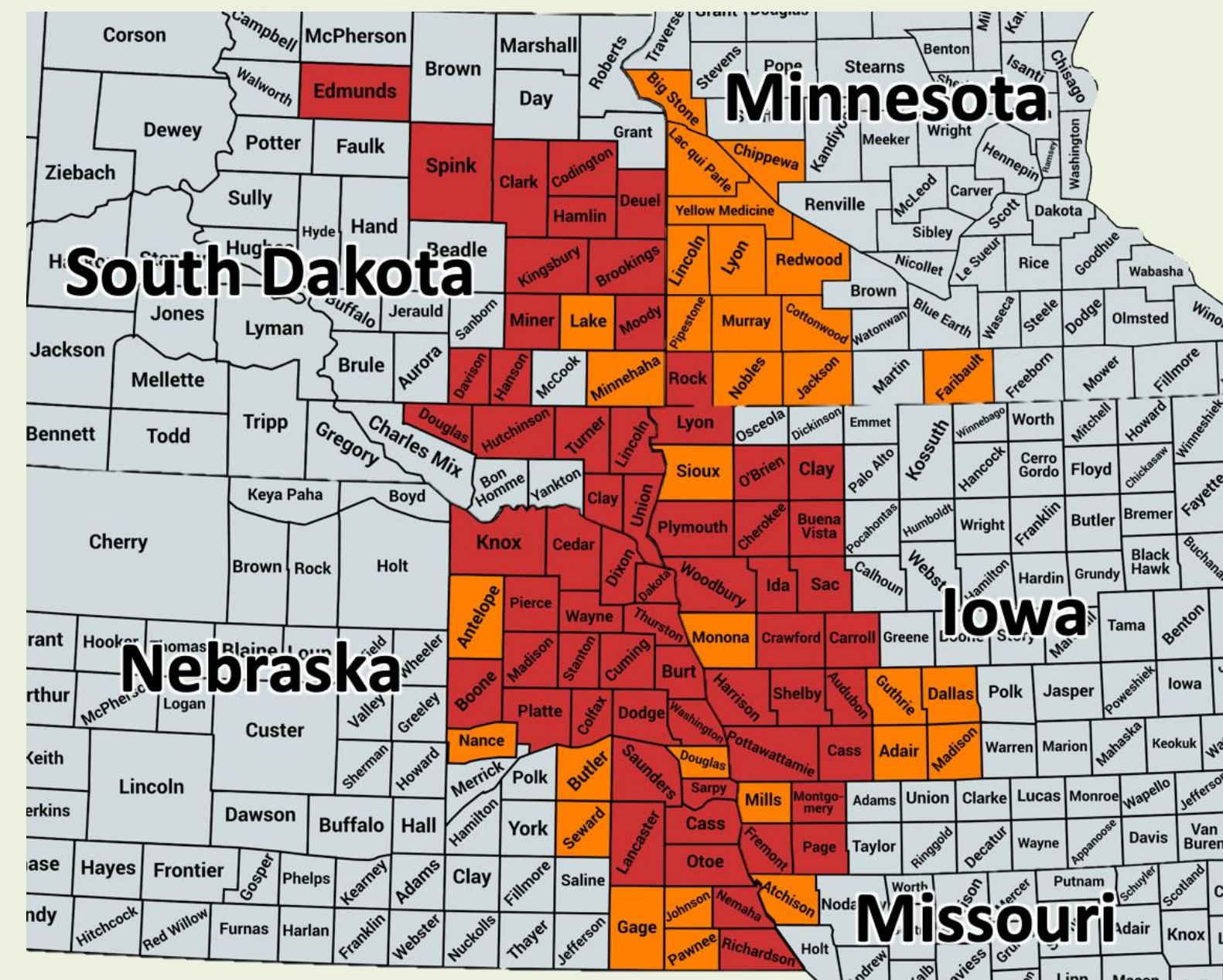


Figure 1. Counties infested with soybean gall midge in 2018 (red) and 2019 (orange).



Figure 2. a) a field with significant injury from soybean gall midge with b) a close up of soybean gall midge larvae feeding within a plant; 1st, 2nd and 3rd instar larvae in lower left corner.

Material and Methods

- Early and late instar larvae were collected from soybean plants in the field and individually exposed to black cardstock (Fig. 3a) and a soil surface (Fig. 3b)
- For each replication, larvae were given five minutes to acclimate to the treatment area followed by 15 minutes of recording the distance that larvae moved in one minute increments
- A total of 15 early instars larvae and 15 late instar larvae were observed for each surface
- A greenhouse study was conducted to evaluate the potential for infestation of a soybean plants
- Ten late instar larvae were placed at 0cm, 5cm, 10cm, 25 cm, and 50cm away from a susceptible soybean plant sown in a 60 cm propagation tray with field soil (Fig. 3c)
- Ten days after treatments plants were dissected for larval presence

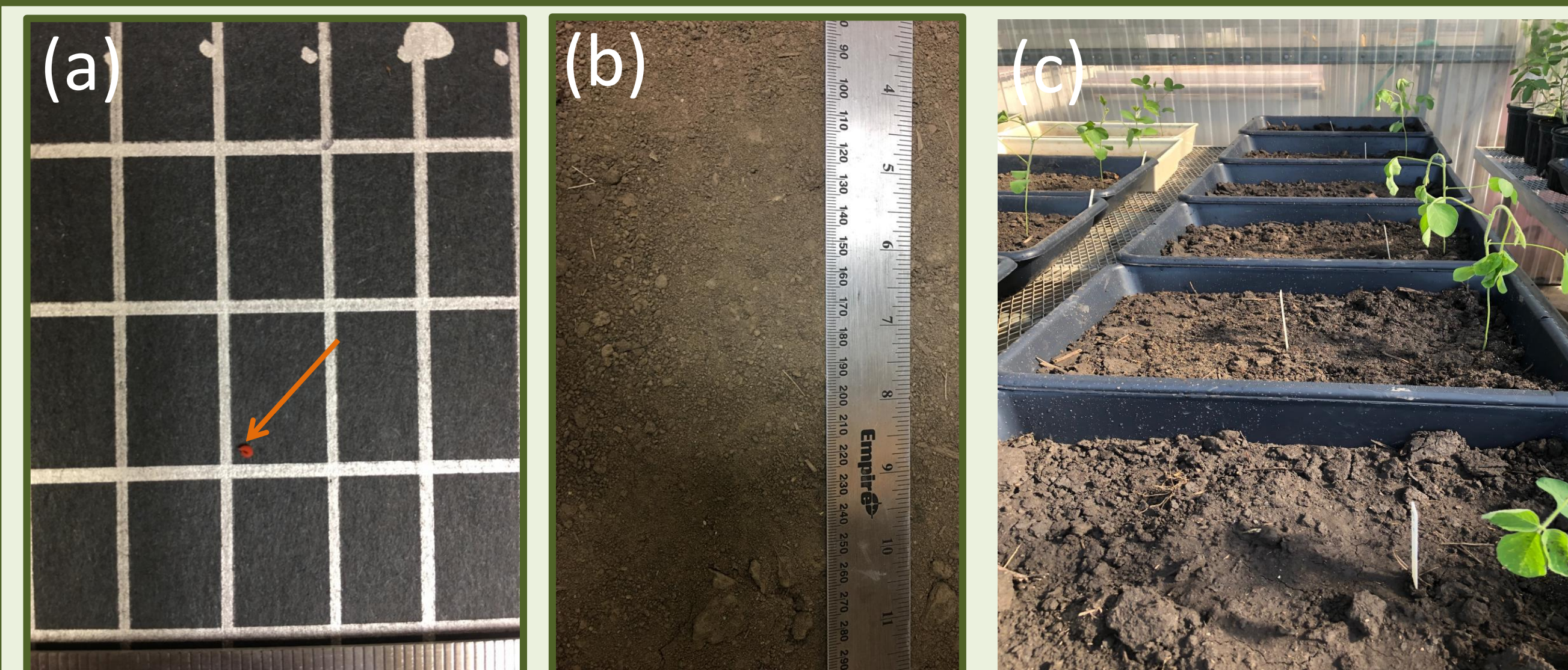


Figure 3. Photos showing the different surfaces (a) black cardstock and (b) field soil for soybean gall midge larval movement. Image (c) shows testing area to determine larval infestation of a healthy soybean plant.

Results

Figure 4. Early instar soybean gall midge movement over time on flat and soil surface.

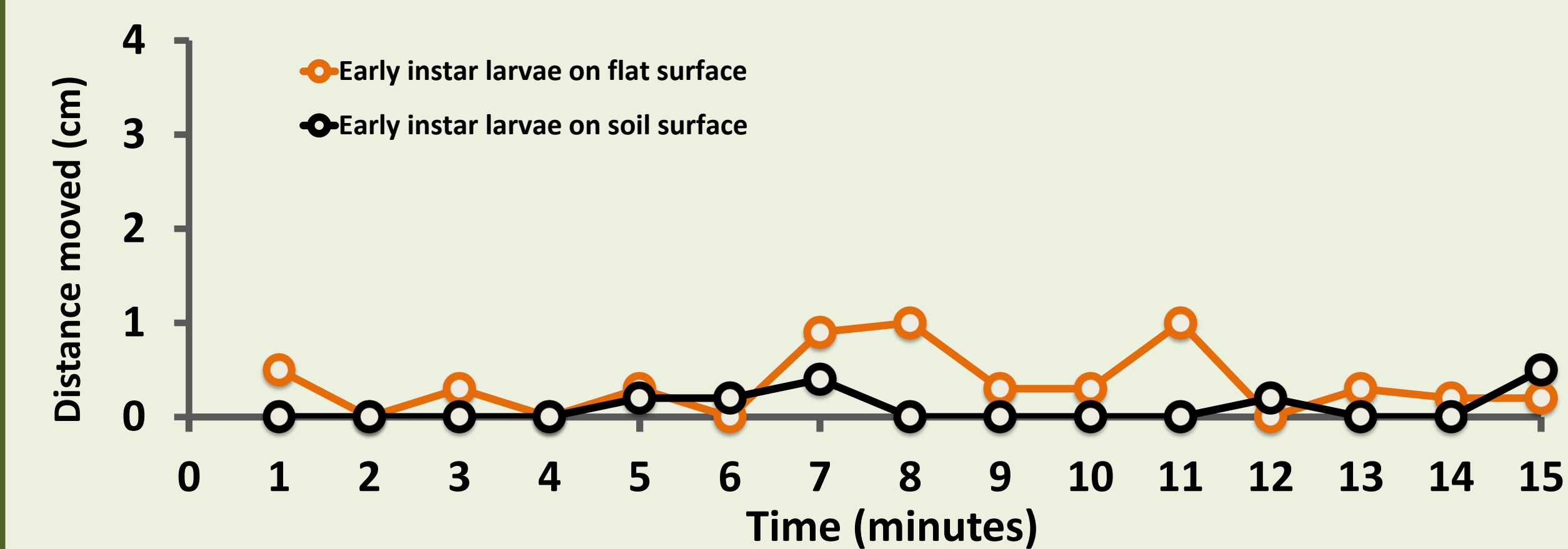


Figure 5. Late instar soybean gall midge movement over time on flat and soil surface.

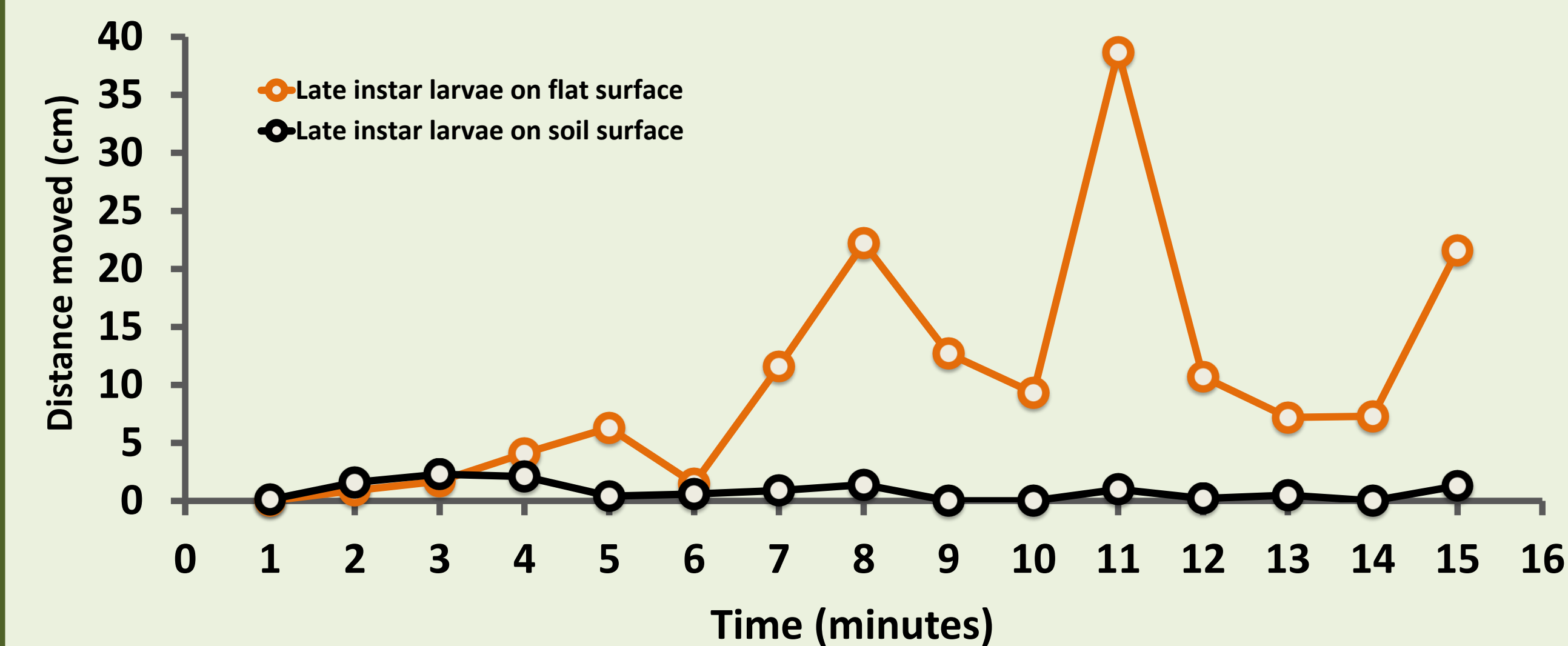
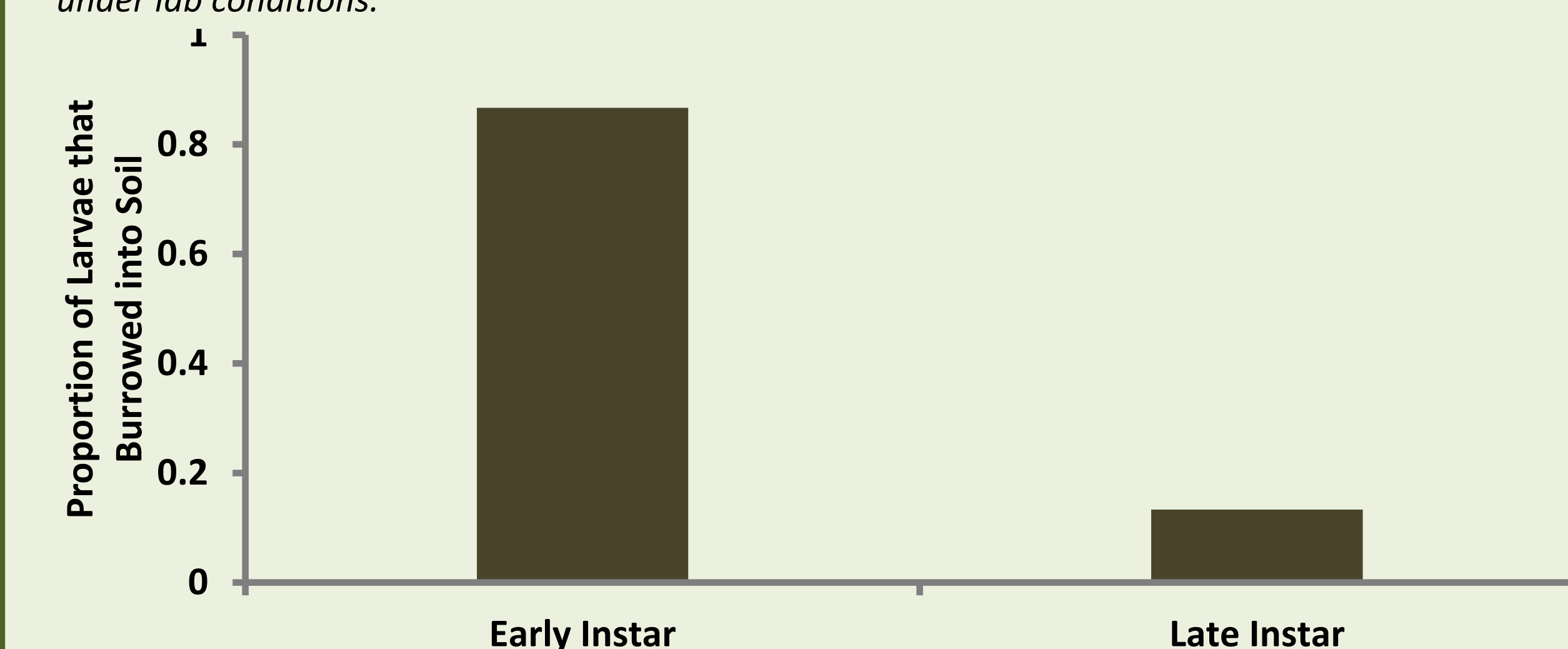


Figure 6. Proportion of early and late instar soybean gall midge larvae that burrowed into the soil under lab conditions.



Results

Early instar

- 73% of the early instar larvae moved on flat surface.
- Total movement of all larvae was 5.30 cm on the flat surface.
- Average larval movement was 0.40 cm on a flat surface (Fig. 4)
- Only 27% of the larvae moved on a soil surface with a total of 1.5 cm and average movement of 0.10 cm (Fig. 4)
- 86.66% of the early instar larvae burrowed in the soil (Fig. 6)

Late instar

- 100% of the larvae moved on flat and soil surfaces.
- On flat surface the total and average movement among all larvae were 156 cm and 10.40 cm, respectively (Fig. 5)
- Late instar larvae on a soil surface had total of 12.4 cm and average movement of 0.90 cm for all larvae (Fig. 5)
- 13.33% of the late instar larvae burrowed in the soil (Fig. 6)

Greenhouse study

- No larval infestation of soybean plants was observed with two replications of the experiment
- Significant soil surface cracking was observed across all treatments and could greatly impact larval movement
- Time of day of larval release was not a factor in this experiment but could significantly impact larval survival and establishment on soybean plants

Conclusion & Discussion

- The result provided are only a preliminary look into SGM larval movement
- Further studies are needed along with field observations to determine the importance of larval movement and infestation potential
- Understanding SGM biology and behavior is essential for developing effective pest management strategies
- SGM larvae were able to move longer distances on flat surfaces when compared to soil
- Late instar SGM present higher ability to move than early instars regardless of surface tested
- Results suggested that SGM larvae present a greater ability to move on flat surface with limited movement on a soil surface
- Larvae were handled and removed from their natural environment, therefore the distance observed may not reflect field conditions

Reference

Gagné, R.J., Yukawa, J., Elsayed, A.K. and McMechan, A.J., 2019. A New Pest Species of *Resseliella* (Diptera: Cecidomyiidae) on Soybean (Fabaceae) in North America, with a Description of the Genus. *Proceedings of the Entomological Society of Washington*, 121(2), pp.168-177