Preliminary studies of host-plant relations and cultivar-specific responses of cotton to Lygus injury

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Background and Justification

The western tarnished plant bug and other Lygus species are key pests of cotton in western arid cotton production regions. In addition, the Lygus complex has become increasingly important in other US cotton production regions. The principal management tactic for Lygus bugs is chemical pesticides, and current recommended treatment levels are nominal. The effectiveness of Lygus management strategies could be improved with detailed knowledge of the cultivar- and plant stage-specific impacts of Lygus. Detailed estimates of instar- or stage-specific injury rates from controlled studies with intact plants are not available. Such estimates, combined with sampling methods of known efficiency, would open new opportunities to estimate or model plant growth stage-specific fruit loss and compensation in relation to Lygus population level and population characteristics (age or stage distribution, sex ratio, reproductive phenology). This information would provide the capability to construct improved management rules specific to crop phenology or yield potential. Procedures developed to obtain quantitative estimates of plant injury should also improve the efficiency with which cotton varieties or breeding populations could be screened for resistance or tolerance prior to more extensive and expensive field evaluations. Identification of useful sources of host plant resistance or tolerance, and incorporation of those traits into commercially acceptable cultivars may increase the economic injury level and thus play a critical role in the development of durable and practical ecologically-based management strategies.

Objectives

Develop methodology to quantify base-line plant response (square/boll abscission) to Lygus feeding, and to rapidly screen varieties or breeding lines for tolerance to plant bugs.

Procedures

Cage Development. Whole plant cages (14”w × 14”w × 24”h) were constructed from acrylic frames and fine mesh (Fig. 1). Each cage contains two access doors: one on top and another hinged door on the bottom half of one side. The bottom of the cage is acrylic and contains a 6” diameter, 4” long acylic tube extending from the bottom. The tube serves two purposes, 1) to allow entry of the plant, and 2) to support the cage in the soil.

Preliminary assays were conducted using greenhouse plants (cv. Maxxa). Six Lygus adults were released into each cage (n = 3) and abscised squares or bolls were collected for three weeks following release. Abscised squares and bolls were dissected to evaluate feeding damage (Fig. 2) and distinguish between physiological and Lygus-induced shed.

Feeding Behavior Assays. We also developed methods using digital video to monitor Lygus feeding behavior. Feeding arenas were created by embedding a ¼” diameter cotton square into

paraffin wax in a covered petri dish. Lygus feeding behavior was recorded for 6 hrs and probing events were determined by monitoring Lygus posture and stylet position (Fig. 3) (Cline and Backus 2002). Our initial assays compared the behavior (feeding time, time on square, etc.) of mated and unmated male and female adults in three age classes (<2 d, 2-4 d, and 7 d since eclosion).

Results and Discussion

Cage Development. Our cage design allows sufficient access to the plant canopy, released Lygus, and the cage floor, and thus easy retrieval of abscised squares/bolls without disturbing Lygus and plants. Square and boll abscission was first recorded 4-5 days after Lygus were released. Small bolls were the first to abscise, and square abscission was only recorded after all small bolls had fallen from plants. Dissection of abscised squares and bolls revealed substantial damage (Fig. 2). A single abscised square did not show damage to anthers, and is thus attributed to physiological shed. These preliminary assays indicate that our cages and methods to distinguish Lygus induced fruit shed are adequate for greenhouse assays evaluating plant response to Lygus feeding.

Feeding Behavior. Lygus spent 55% of their time feeding/probing while on squares. Mated females probed squares many more times than males or unmated females. Future assays will be conducted with HD cameras recording from two angles. Future goals include comparisons of adults vs. nymphs, different hosts, and social interactions. These methods will provide useful insight into Lygus feeding behavior and direction for greenhouse comparisons, and will aid in interpretation of results from greenhouse studies.

References

Cline, A.R. & E.A. Backus. 2002. Correlations among AC electronic monitoring waveforms, body postures, and stylet penetration behaviors of *Lygus hesperus* (Hemiptera: Miridae). Environ. Entomol. 31:538-549.

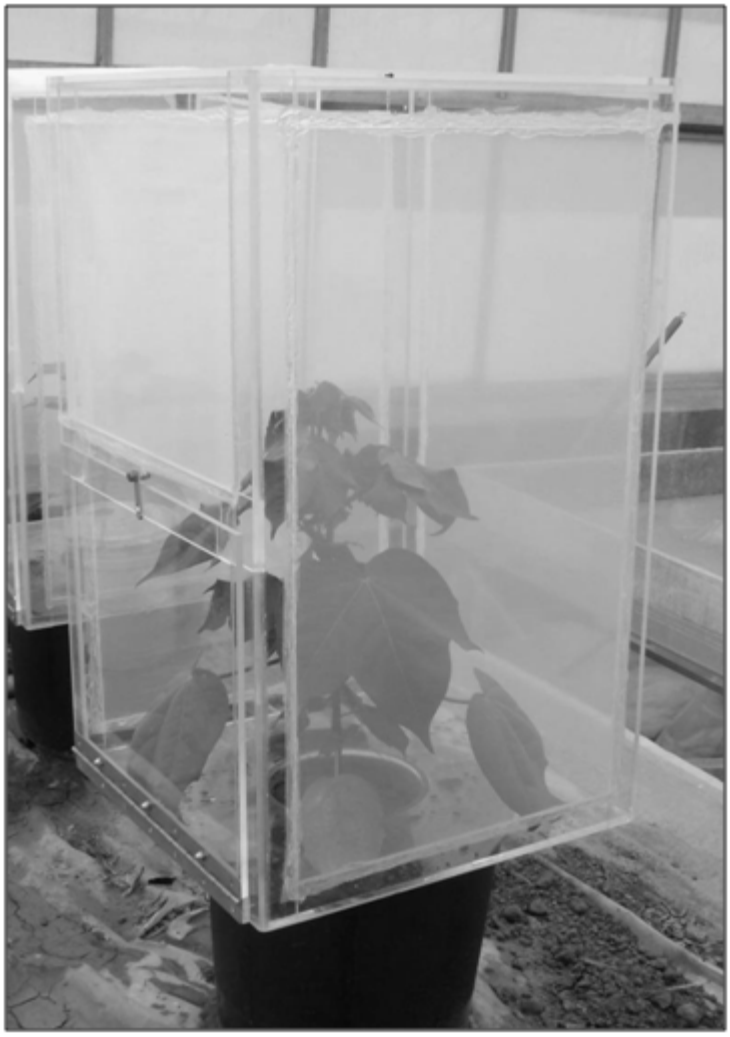

Fig. 1. Whole plant *Lygus* cages. Abscised squares/bolls can be easily collected from the bottom of cages and assessed for *Lygus* damage

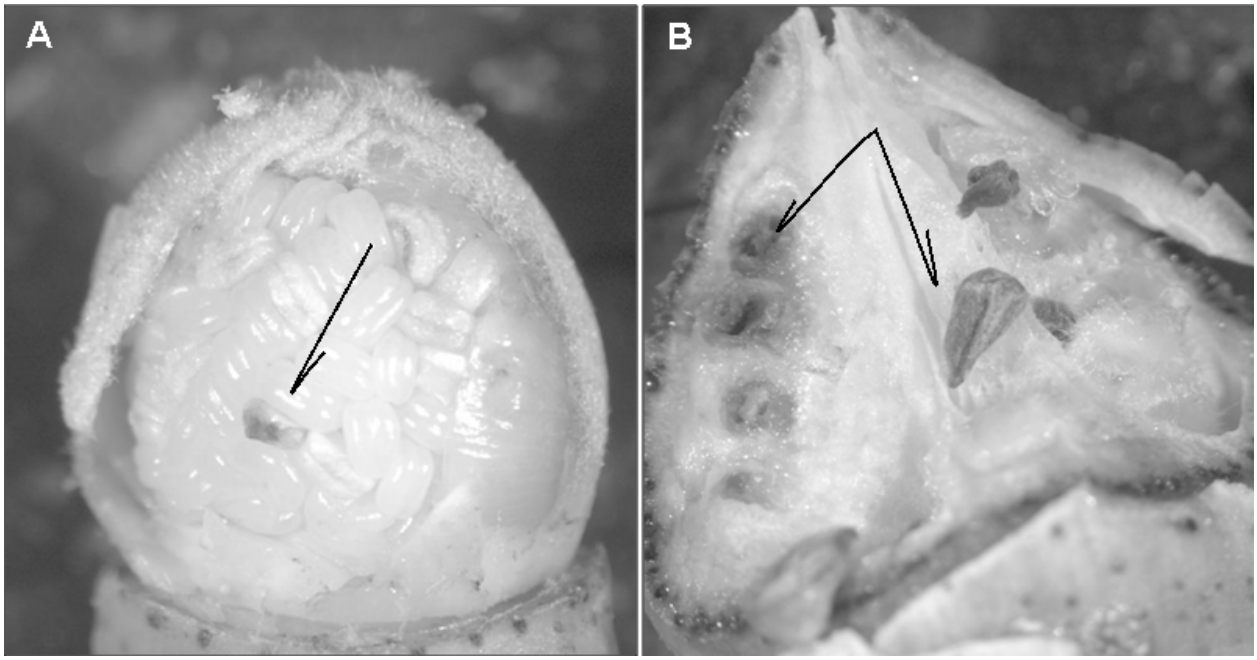

Fig. 2. Cotton square (A) and boll (B) dissected to expose Lygus damaged anthers and seeds, respectively (arrows).

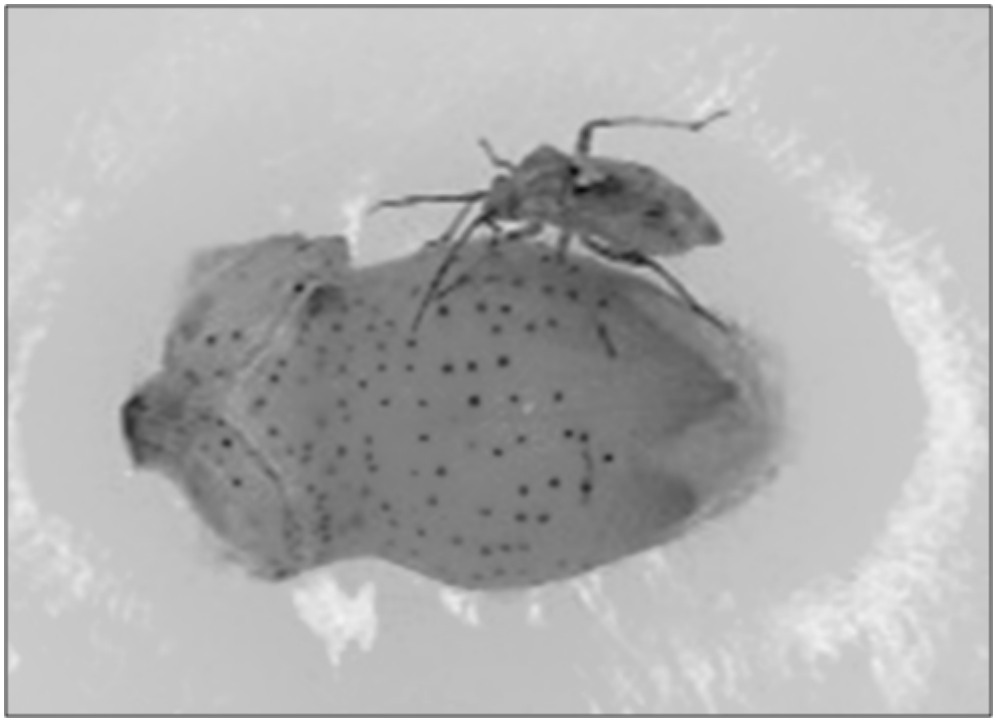
Fig. 3. Lygus adult feeding on a cotton square with feeding stylets partly inserted into the host.