2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

THE DEVELOPMENT OF TARNISHED PLANT BUG ON VARIOUS CORN TISSUE

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Abstract

Corn may play an important role in the season-long dynamics of tarnished plant bug infesting cotton. During June, VT (tasseling) and R1 (silking) stage field corn may be very attractive to ovipositing tarnished plant bugs. Consultants and researchers have collected nymphs and adult stage tarnished plant bugs from corn; however, it is still unknown if the insect is able to reproduce on the crop. Our objectives for this study were to determine if the pest can develop on corn tissue and to quantify egg production for tarnished plant bug adults reared on the crop. There were no differences in survival rates of tarnished plant bug fed milk-stage kernels collected from the middle and base of the ear when compared to the broccoli control. Plant bugs reared on broccoli and milk-stage kernels took 11.5 d and 11.6 d, respectively, to become adults. Females reared on broccoli produced significantly more eggs than those females reared on milk-stage kernels, but not those reared on corn cob tips which contained blister- and milk-stage kernels. These results indicate that milk-stage corn seed is an excellent food source for developing tarnished plant bug. Because developing corn seed from healthy ears is unavailable to plant bug feeding, ear damage by the corn earworm/bollworm is probably critical for the tarnished plant bug to feed and complete its normal development. Future research will study the life history of tarnished plant bug on corn grown in the field and population densities emerging from silk-feeding resistant and susceptible corn lines will be estimated to determine the relative impact of infestations in mid- to late-season cotton.

Background

The tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), is a destructive pest of many cultivated plant species throughout the world (Kelton 1980). For the crops that are grown in the Mississippi Delta region of the United States, cotton, *Gossypium hirsutum* L., is highly susceptible to damage by this insect. Cotton plants are susceptible to damage by the insect at any time prior to the formation of mature fruit (Scales and Furr 1968, Hanny et al. 1977). The near eradication of the cotton boll weevil, *Anthonomus grandis* Boheman, and the extensive planting of transgenic cotton to control Lepidopteran pests, has reduced overall insecticide use in the MS Delta. This has led to more frequent increases in the population densities of tarnished plant bugs in the MS Delta, thus, often promoting the species to a target pest for the crop grown in the region.

Movement of the tarnished plant bug into cotton is related to the phenology of both the crop, non-cotton crops, and wild host plant species growing near the fields (Snodgrass et al. 1984). Adults that move into cotton in the spring and early summer, are produced on many of these plant species (Snodgrass et al. 1984). Corn production has returned to the Mississippi Delta after a 30 year hiatus which began in the mid-1960's. Need for a rotational crop with cotton and soybean, passage of the Freedom to Farm Act of 1995, and local demand for grain by catfish and poultry producers have revived the crop's production in the area. The crop plays a central role in the season-long dynamics of some insect pests [e.g. *Helicoverpa zea* (Boddie)] infesting cotton. During June, VT (tasseling) and R1 (silking) stage field corn may be very attractive to ovipositing tarnished plant bug (Ritchie et al. 1992). Consultants and researchers have collected nymphs and adult stage tarnished plant bugs from corn, however, it is still unknown if the insect is able to reproduce on the crop. If corn is determined to be a good host for the pest, control of the insect on the crop may be important for management of the insect. Our objectives for this study were to determine if the tarnished plant bug can develop on corn tissue and to quantify egg production for tarnished plant bug adults reared on the crop.

Procedures

Pioneer corn hybrid, P3394, was planted at Stoneville, MS 2002 over multiple dates. New silks, milk stage (R3) kernels, milk stage corn cob tips that included kernels, and leaves from R1 stage (silking) corn were harvested (Ritchie et al. 1992). Corn tissue was placed into 30 ml diet cups prepared with 5 ml of 1% agar solution poured into the base of the cup. The agar solution increased the RH in the cup but provided no nutrition for the insects. One, first-instar tarnished plant bug nymph, was placed into each cup. Insects were checked daily for mortality and general health. Corn tissue was replaced with fresh corn tissue when the quality of the original tissue began to deteriorate. Percent survival to adult and days to adult were recorded. Females reared on the various corn tissue and broccoli control were bred to males reared in the laboratory on broccoli. The cumulative number of eggs oviposited by the females on green bean pods were recorded. All test were conducted as a randomized complete block design. Treatment means were analyzed using REML-ANOVA (PROC MIXED, Littell et al. 1996) and separated using LSMEANS at $\propto$ 0.05 (SAS Institute 1989).

Results

There was a significant difference among entries for percent survival to adult for tarnished plant bug fed corn tissue ($F = 16.54$, df = 4,10, $P = 0.0002$). Notably, there were no differences in survival rates of tarnished plant bug fed milk-stage kernels and corn cob tips containing blister- and milk-stage kernels when compared to the broccoli control (Figure 1). Zero and 50 percent of the tarnished plant bugs were able to survive on corn leaves and silks, respectively. There was a significant difference among entries for the number of days for the tarnished plant bug to develop to adult ($F = 674.30$, df = 4,112, $P < 0.0001$). Tarnished plant bugs reared on corn cob tips took 13.0 days to become adults which was significantly more than broccoli and kernels (11.5 d and 11.6 d, respectively) and significantly less than silks (17.4 d, Figure 2). These results indicated that corn kernels and cob tips, which contained milk stage kernels, are an excellent food source for developing tarnished plant bug with kernels being as suitable for development as the broccoli control which is used to rear the insect in the laboratory (Snodgrass and McWilliams 1992).

There were significant differences among entries for 7 d and 14 d cumulative eggs produced from females reared on test entries ($F = 4.39$, df = 3,20, $P = 0.0158$; and, $F = 6.06$, df = 3,20, $P = 0.0042$). Females reared on broccoli produced significantly more eggs than those females reared on kernels, but not those reared on corn cob tips (Figure 3). There was approximately a five-fold decrease in eggs produced by silk-reared females compared to females reared on broccoli.

Discussion

Our results indicated that the tarnished plant bug can develop effectively in the laboratory on milk-stage corn kernels and can partially develop, but not nearly as efficiently, on corn silks. Development by the insect on corn in the field is not proven. An important factor in the development of the insect in the field is the temporal and physical unavailability of suitable corn seed needed by the insect to complete development in a normal period of time with full reproductive ability. Suitable corn tissue is made available to the insect for approximately 12 days after the tassel begins to emerge for tarnished plant bug oviposition, until the silks dry down and are no longer a suitable food source (Figure 4). Unless the ear husk is damaged, the developing corn seed is unavailable for the insect to complete its normal development. Under ideal conditions, the tarnished plant bug requires approximately 19 days from egg oviposition to adult emergence at 30° C (Ridgway and Gyrisco 1960).

It is possible, under certain conditions, that the temporal and physical availability of suitable corn tissue for tarnished plant bug development would be ideal. Figure 4 diagrams one possible scenario for the development of one generation of tarnished plant bug on corn. At the V ~18 (Ritchie et al. 1992) stage of corn development, the tassel begins to emerge and is first made available for oviposition by fecund tarnished plant bugs. At the VT corn stage, pollen shed begins and tarnished plant bug egg hatch begins to occur. At the R1 corn stage, silking begins. Three days after silking begins, a critical point for the development of the tarnished plant bug occurs when silk and pollen production cease in the plant. At this critical point, normal development by the tarnished plant bug will eventually end unless R2 (blister) or R3 (milk) stage corn seed is made available to the insect. Because the corn seed is enclosed within the ear husk, a mode of entry to the seed is needed, such as from damage caused by the corn earworm/bollworm. Once this damage occurs, the tarnished plant bug can reach the seed so that normal development can continue on R2 and R3 stage corn until the adult stage is reached.

Future research will involve determining the location and timing of tarnished plant bug oviposition on corn. The life history of tarnished plant bug development on corn will be examined and the population densities of plant bugs developing on corn will be quantified. Also, the effect of silk-feeding resistance in transgenic corn in reducing tarnished plant bug populations in corn will be tested. The authors have noted that late instar tarnished plant bugs found on corn are usually from plants that have been damaged by the corn earworm/cotton bollworm. Large scale strip-plots of cotton and silk-feeding resistant and susceptible corn lines will be grown to determine the relative differences in plant bug densities emerging and infesting mid- to late-season cotton.

Acknowledgments

The authors wish to thank Melanie Pollan, Loria Courtney, Carolyn Davis, and Crystal Terry for their assistance in this project.

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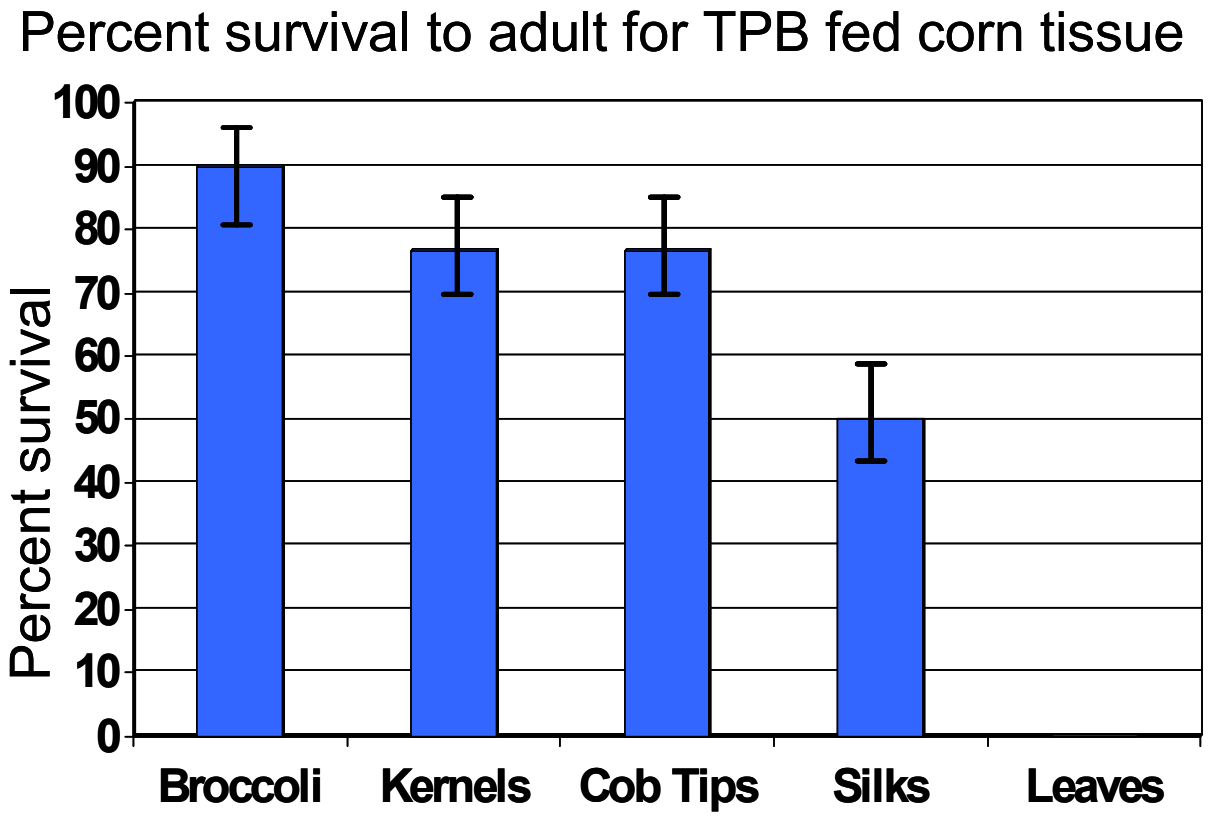

Figure 1. Mean percent survival to adult for tarnished plant bug reared on corn tissue and broccoli control. Treatment means analyzed using REML-ANOVA (PROC MIXED) and separated using LSMEANS at $\propto$ 0.05.

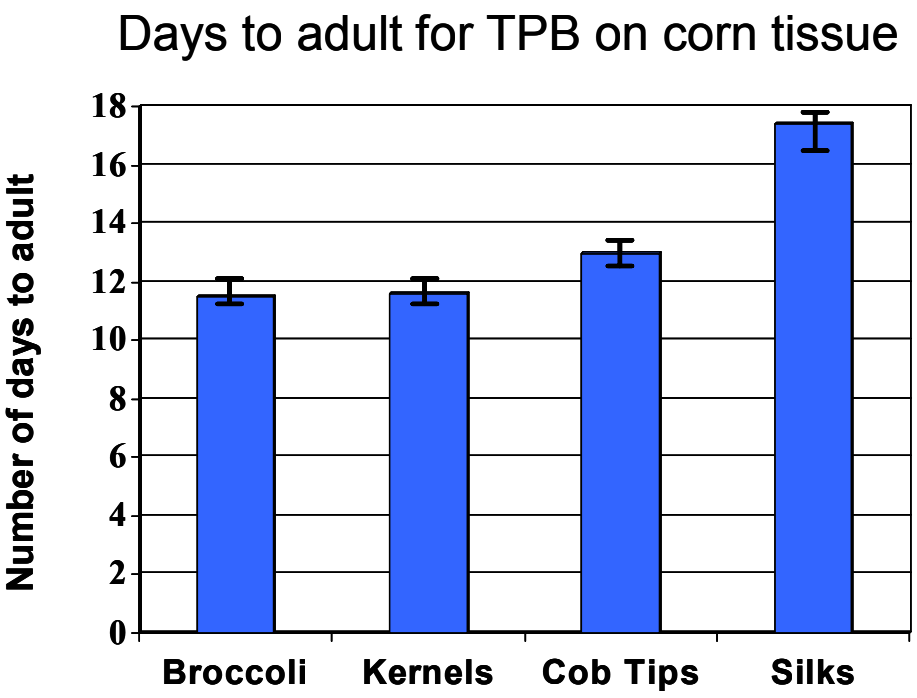

Figure 2. Mean days to adult for tarnished plant bug reared on corn tissue and broccoli control. Treatment means analyzed using REML-ANOVA (PROC MIXED) and separated using LSMEANS at $\propto$ 0.05.

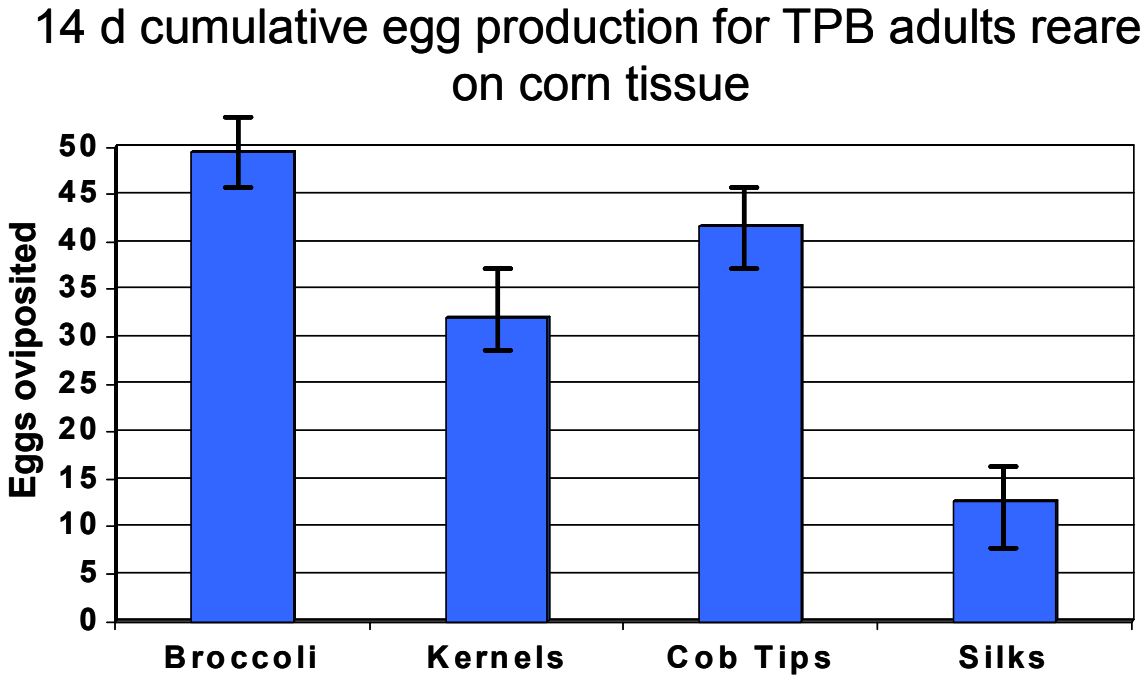

Figure 3. Mean 14 d cumulative egg production for female tarnished plant bug adults reared on corn tissue and broccoli control. Treatment means analyzed using REML-ANOVA (PROC MIXED) and separated using LSMEANS at $\propto$ 0.05.

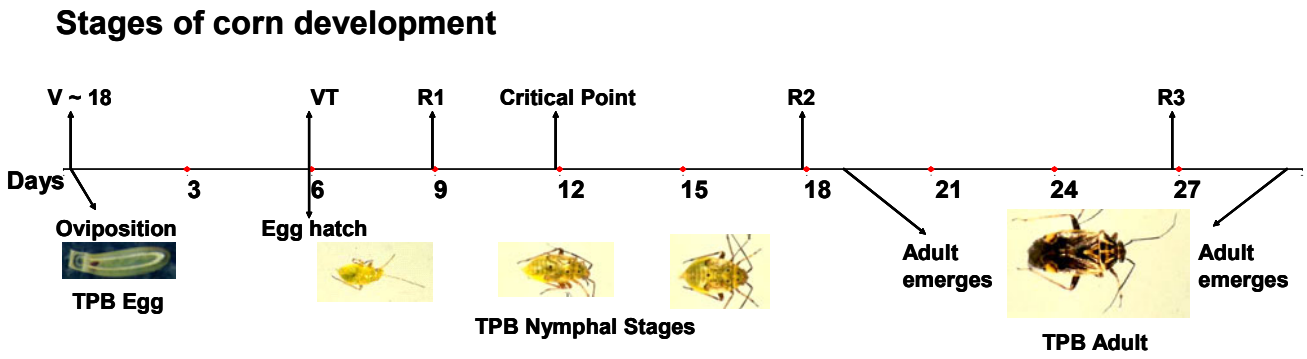

Figure 4. Possible scenario for tarnished plant bug development on corn. Injury to the ear at the critical point is necessary for the tarnished plant bug to complete its life cycle on the developing corn seed.