RESIDUAL CONTROL OF STINK BUGS AND LEAFFOOTED BUG WITH SELECTED INSECTICIDES

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Abstract

The boll-feeding complex of true bugs is the number one insect pest group of cotton in the southeastern USA. This group of bugs is comprised of phytophagous species of stink bugs, leaffooted bugs, and plant bugs. Of these groups, the pentatomids are most important in cotton, especially in South Carolina and Georgia, and require control with insecticides, primarily organophosphates and pyrethroids, annually in the crop. Adoption of the dynamic boll-injury treatment threshold to assess populations of and injury from stink bugs has become standard practice in the region, but it requires the use of effective insecticides to reduce insect numbers and symptoms of feeding injury. Because duration of insecticide control is important in suppressing populations of stink bugs and reducing levels of boll injury, we examined the residual control of two widely used classes of insecticides (pyrethroids and organophosphates) in controlling three important species, the brown stink bug (BSB), *Euschistus servus* (Say), the southern green stink bug (SGSB), *Nezara viridula* (L.), and the Eastern leaffooted bug (LFB), *Leptoglossus phyllopus* (L.). The organophosphate dicrotophos provided excellent control of BSB, SGSB, and LFB at < 1 and 24 hr. after spray and fair-to-good control up to 48 hr., with control declining after 48 hr. The pyrethroids, except for bifenthrin, provided limited immediate and residual control of BSB but excellent control of SGSB and LFB out to 7 days after insecticide spray.

Introduction

Annually, a boll-feeding complex of bugs, comprised of stink bugs (Pentatomidae), plant bugs (Miridae), and leaffooted bugs (Coreidae), infests Upland cotton, *Gossypium hirsutum* (L.), at high levels across the Cotton Belt (Cook and Threet 2021), resulting in significant control costs for and yield losses to the crop. In the southeastern USA, specifically South Carolina and Georgia, the stink bug complex is the most important insect pest group of cotton. Within this complex, the southern green stink bug (SGSB), *Nezara viridula* (L.), and the brown stink bug (BSB), *Euschistus servus* (Say), are unquestionably the two most important species of phytophagous stink bugs in the crop. Additionally, the Eastern leaffooted bug, (LFB), *Leptoglossus phyllopus* (L.), can join BSB and SGSB to constitute a unique group within the complex that is able to feed on and cause injury to bolls for an extended period of time during the season. Because of a matching interval of susceptibility of bolls to injury by the complex of bugs, good immediate and extended efficacy of insecticides is desirable, especially any protracted residual control. The pyrethroids and organophosphates represent the majority of insecticides used for control of boll-feeding bugs in the southeastern USA, and the applications often occur when bollworm, *Helicoverpa zea* (Boddie), is important. Historically, the pyrethroids have been used to control bollworm and stink bugs concurrently, but efficacy on bollworm has declined over time (Figure 1). We addressed the residual activity of insecticides commonly used in the region to control stink bugs in cotton and did follow-up trials to investigate any changes or similarities over time.

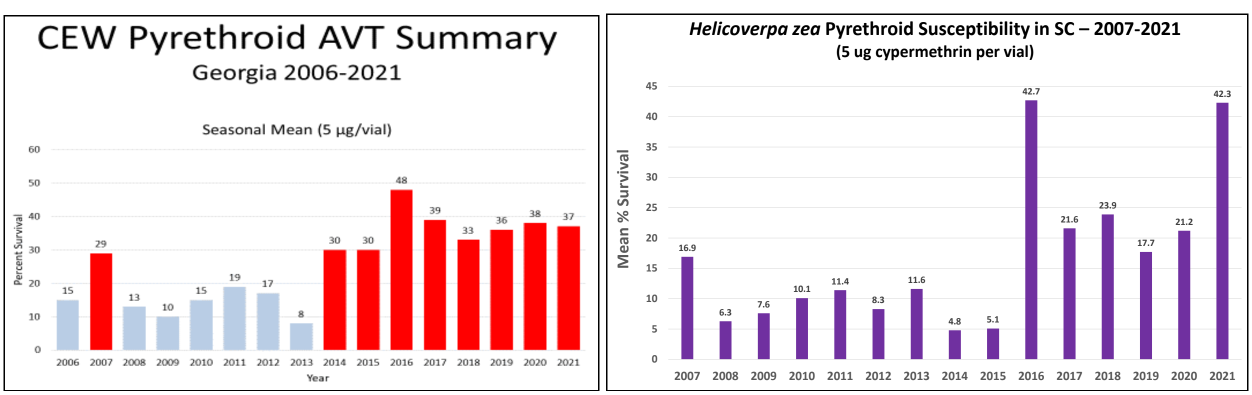

Figure 1. Survivorship of bollworm in bioassays with a pyrethroid insecticide in Georgia and SC from 2006-2021.

Materials and Methods

During 2000, 2008, and 2021, replicated trials were conducted in the field and laboratory in Tifton, GA, and Blackville, SC, to assess the residual control of selected insecticides on several species of hemipterans. In field trials during 2000, 2008, and 2021, polyester net cages covering the top 5 nodes were tied to the main stem and folded down before treatment with dicrotophos (Bidrin, 0.5 lb. ai/acre), deltamethrin (Decis, 0.03 lb. ai/acre), or *lambda*-cyhalothrin (Karate/Warrior II, 0.04 lb. ai/acre) at maximum label rates. Cages were infested with 5 or 10 specimens of BSB, SGSB, or LFB at intervals of <1 hr., 1, 2, 3, 5, 7, 10, or 14 d after spray treatments (DAT) and sealed with cable ties for an exposure period of 3 (2000) or 1 (2008 and 2021) d before examination of mortality. In a laboratory trial during 2008, plots were untreated or sprayed with dicrotophos (0.5 lb. ai/acre), bifenthrin (Capture/Brigade, 0.1 lb. ai/acre), or *zeta*-cypermethrin (Mustang Max, 0.016 or 0.025 lb. ai/acre) before leaves were collected at various intervals (0-7 DAT) and placed in Petri dishes, and bugs were enclosed on leaves for 48 hr. before an assessment of mortality. Data were subjected to a one-way analysis of variance using Agricultural Research Manager (ARM) software (GDM Solutions 2021) and transformed, if necessary, before presenting means.

Results and Discussion

During 2000, in a trial addressing residual control of selected insecticides on stink bugs, adults of SGSB survived in all cohorts at less than 20% mortality when caged for 3 d on cotton terminals untreated with insecticide (Figure 2). Mortality of SGSB in cohorts of exposure to caged terminals at 0, 1, 3, 5, or 7 d post-spray with insecticides was 100, 100, 100, 90, or 100%, respectively, for bugs exposed to the pyrethroid deltamethrin (Decis). At the same exposure times, mortality of SGSB exposed to residual of the organophosphate dicrotophos (Bidrin) was 100%, until 5 and 7 d after insecticide application, when control decreased to 80 and 23%, respectively (Figure 2).

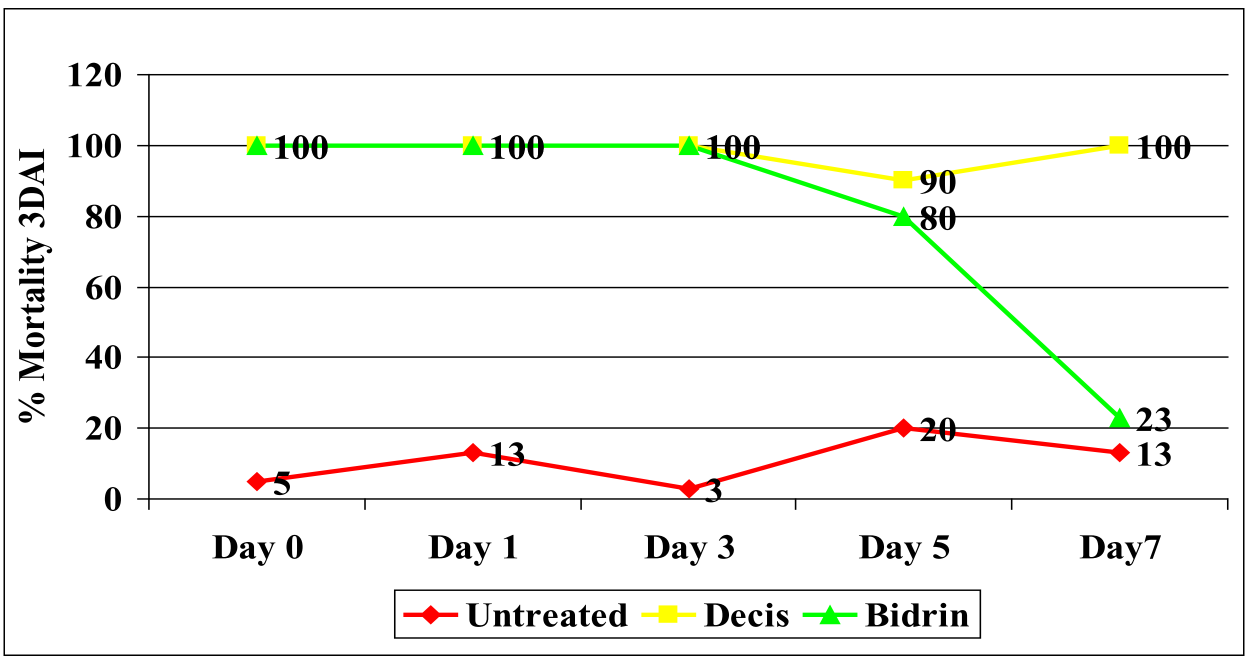

Figure 2. Mortality of southern green stink bug (SGSB) adults three days after infestation (DAI) caged on cotton terminals after various post-treatment intervals with deltamethrin (Decis at 0.03 lb. ai/acre) or dicrotophos (Bidrin at 0.5 lb. ai/acre) and compared with an untreated control in Tifton, GA, during 2000.

During 2008, adults of BSB survived at less than 10% mortality across all cohorts when enclosed in Petri dishes for 2 d on cotton leaves untreated with insecticide (Figure 3). Mortality of BSB in cohorts of exposure to enclosed leaves at 0-4 d post-spray with bifenthrin was high (95-100%) before decreasing to 80, 40, and 10% at 5-7 d, respectively, after treatment. At the same exposure times, mortality of BSB to residual of dicrotophos on leaves was 100%, until 3 d after insecticide application, when control decreased slightly but remained above 80% until 7 d (Figure 3). Mortality of BSB was 100 and 65% for the high and low rates, respectively, of the pyrethroid *zeta*-cypermethrin immediately after treatment (0 d), but both dropped to less than 40 by 4 d after treatment (Figure 3).

Some fumigant activity could have been possible inside of Petri dishes, as insecticides potentially could have volatilized in the small enclosures.

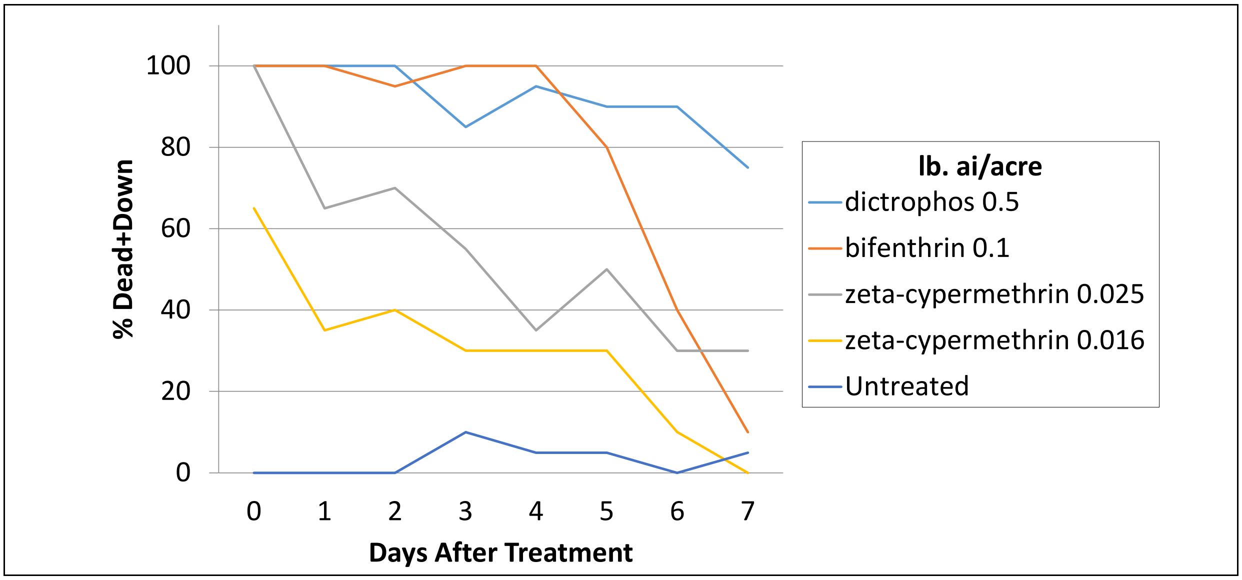

Figure 3. Mortality of brown stink bug (BSB) adults 48 hr. after enclosure in Petri dishes on cotton leaves following various post-treatment intervals with dicrotophos, bifenthrin, or *zeta*-cypermethrin and compared with an untreated control in Tifton, GA, during 2008.

Adults of BSB survived in all cohorts at 5% or less mortality, except for the 7-d cohort, when caged for 1 d on cotton terminals untreated with insecticide (Figure 4). Because mortality in the untreated control was elevated for the 7-d cohort, results for that timing should have been adjusted for control mortality. If control mortality was considered, mortality of BSB in all cohorts of exposure (<1, 24, 48 hr. and 7 and 14 d post-spray) would be 17% (<1 hr.) or less for bugs exposed to the pyrethroid *lambda*-cyhalothrin (Figure 4). At the same exposure times, mortality of BSB exposed to residual of the organophosphate dicrotophos was 96.7%, until 48 hr. after insecticide application, when control decreased to 66.7%. Little to no residual control of BSB was observed with dicrotophos 7 and 14 d post-spray, if elevated control mortality in the 7-d cohort is considered (Figure 4).

Adults of SGSB survived in all cohorts at 5% or less mortality when caged for 1 d on cotton terminals untreated with insecticide (Figure 5). Mortality of SGSB in all cohorts of exposure, except the 14-d residual, was high (89-100%) for bugs exposed to *lambda*-cyhalothrin (Figure 5). At the same exposure times, mortality of SGSB exposed to residual of dicrotophos was high (92-93%), until 48 hr. after insecticide application, when control decreased to 70% or less. Reduced residual control of SGSB with dicrotophos was observed after the 48-hr treatment (Figure 5).

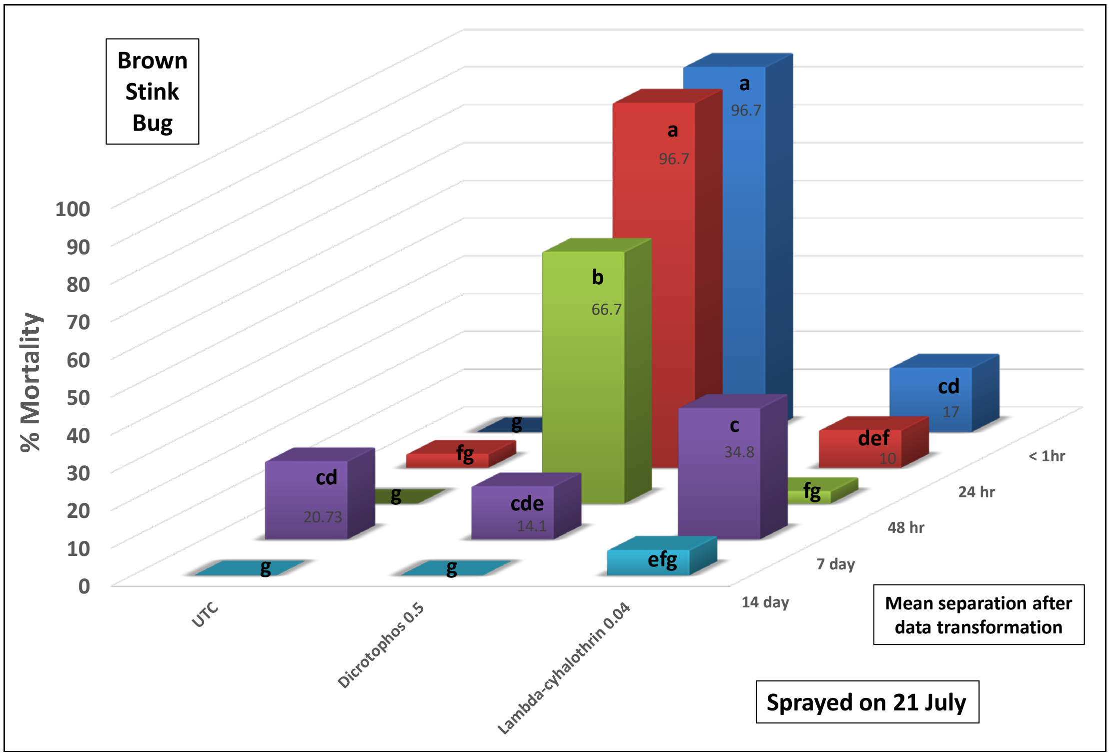

Figure 4. Mortality of brown stink bug (BSB) adults caged on cotton terminals (1-d exposure) after various post-treatment intervals (<1 hr. to 14 d) with dicrotophos (0.5 lb. ai/acre) or *lambda*-cyhalothrin (0.04 lb. ai/acre) and compared with an untreated control in Blackville, SC, during 2008.

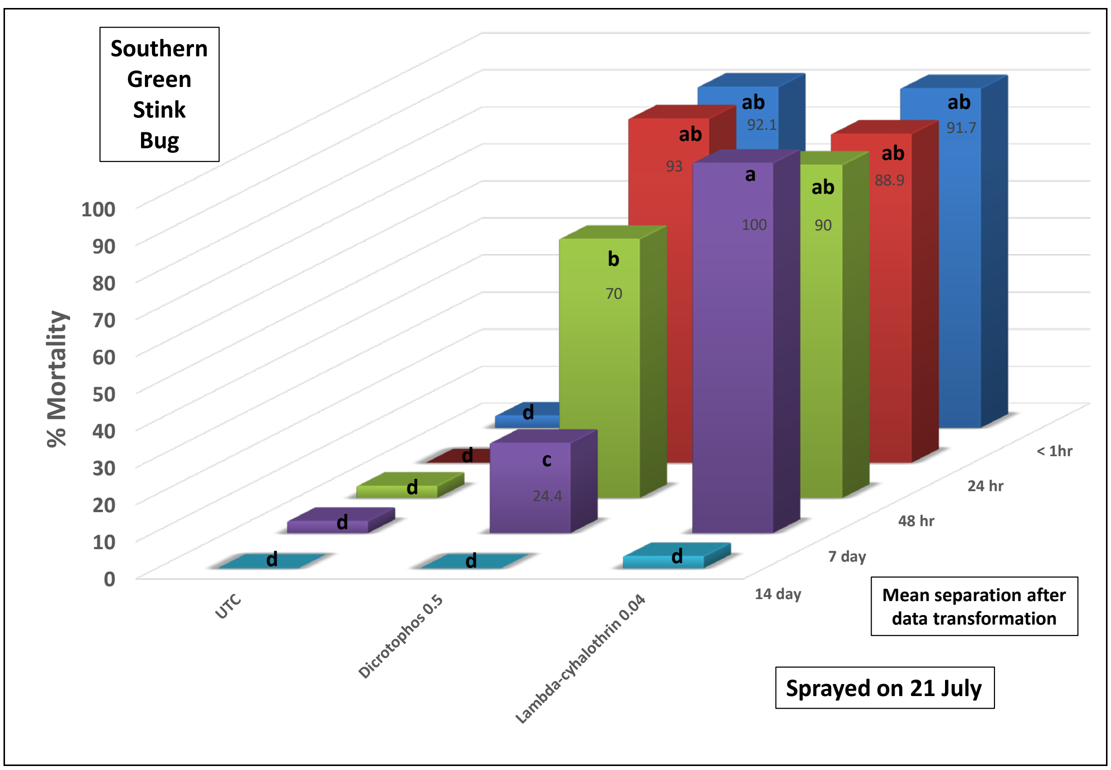

Figure 5. Mortality of southern green stink bug (SGSB) adults caged on cotton terminals (1-d exposure) after various post-treatment intervals (<1 hr. to 14 d) with dicrotophos (0.5 lb. ai/acre) or *lambda*-cyhalothrin (0.04 lb. ai/acre) and compared with an untreated control in Blackville, SC, during 2008.

Adults of LFB survived in all cohorts at around 10% or less mortality, except for the 7-d cohort, when caged for 1 d on cotton terminals untreated with insecticide (Figure 6). Because mortality in the untreated control was elevated for the 7-d cohort, results for that timing should have been adjusted for control mortality. Mortality of LFB in all cohorts of exposure (<1, 24, 48 hr. and 7 d post-spray), except the 14-day treatment, was high (90-100%) for bugs exposed to *lambda*-cyhalothrin (Figure 6). At the same exposure times, mortality of LFB exposed to residual of dicrotophos was high (96.7-100%), until 48 hr. after insecticide application, when control decreased to 53.3%. Reduced residual control of LFB with dicrotophos was observed after the 48-hr treatment (Figure 6).

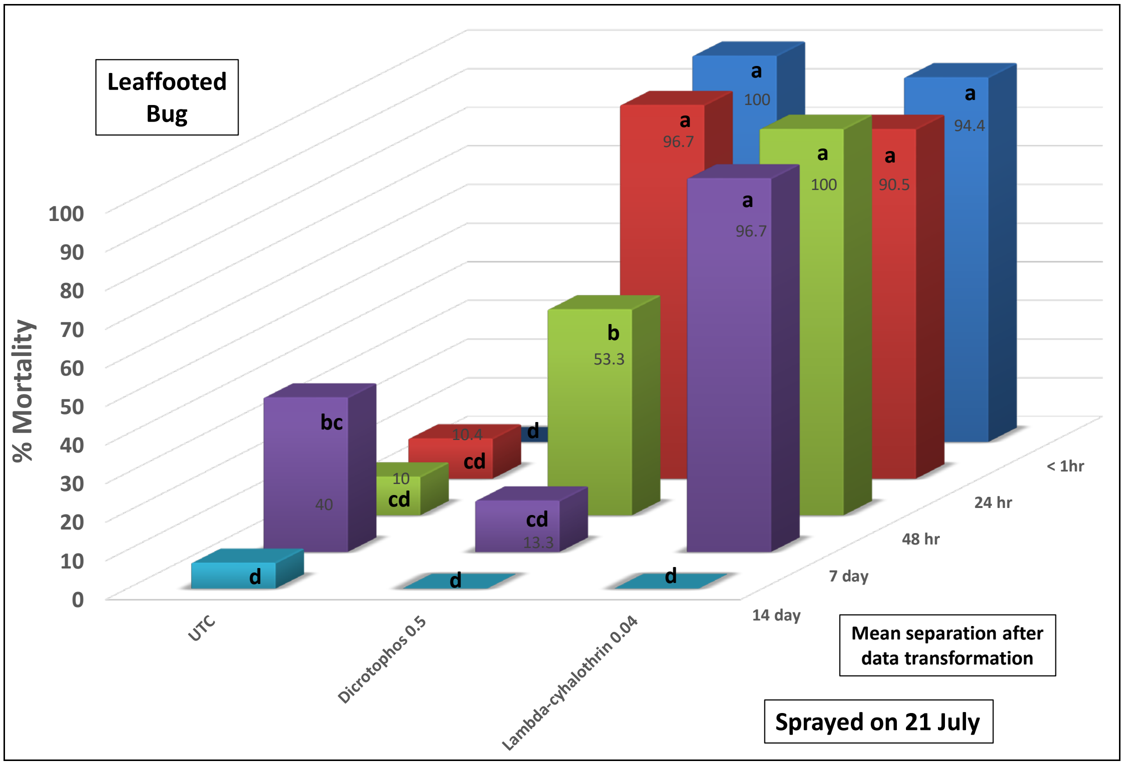

Figure 6. Mortality of leaffooted bug (LFB) adults caged on cotton terminals (1-d exposure) after various post-treatment intervals (<1 hr. to 14 d) with dicrotophos (0.5 lb. ai/acre) or *lambda*-cyhalothrin (0.04 lb. ai/acre) and compared with an untreated control in Blackville, SC, during 2008.

In 2021, the cage experiments were repeated with BSB and SGSB in South Carolina (Figure 7). Adults of BSB survived in all cohorts at 5% or less mortality, except for the 7-d cohort, when caged for 1 d on cotton terminals untreated with insecticide (Figure 7). Because mortality in the untreated control was elevated for the 7-d cohort, results for that timing should have been adjusted for control mortality. Mortality of BSB exposed to *lambda*-cyhalothrin at <1 hr. was 40%, but that decreased significantly for all remaining cohorts of exposure (24 and 48 hr. and 7 and 14 d post-spray) (Figure 7). At the same exposure times, mortality of BSB exposed to residual of dicrotophos was 100% at <1 hr. but decreased to 83.3% at the 24-hr residual timing and less than 40% at 48 hr. after insecticide application. Little residual control of BSB was observed with dicrotophos 7 and 14 d post-spray, if elevated control mortality in the 7-d cohort is considered (Figure 7).

Adults of SGSB survived in all cohorts at around 10% or less mortality when caged for 1 d on cotton terminals untreated with insecticide (Figure 8). Mortality of SGSB in the <1-, 24-, and 48-hr cohorts of exposure was 100% for bugs exposed to *lambda*-cyhalothrin, with control dropping to 40 and 26.7% at the residual timings of 7 and 14 d (Figure 8). At the same exposure times, mortality of SGSB exposed to residual of dicrotophos was 100% until 48 hr. after insecticide application, when control decreased to about 49% or less. Negligible residual control of SGSB with dicrotophos was observed after the 48-hr treatment (Figure 8).

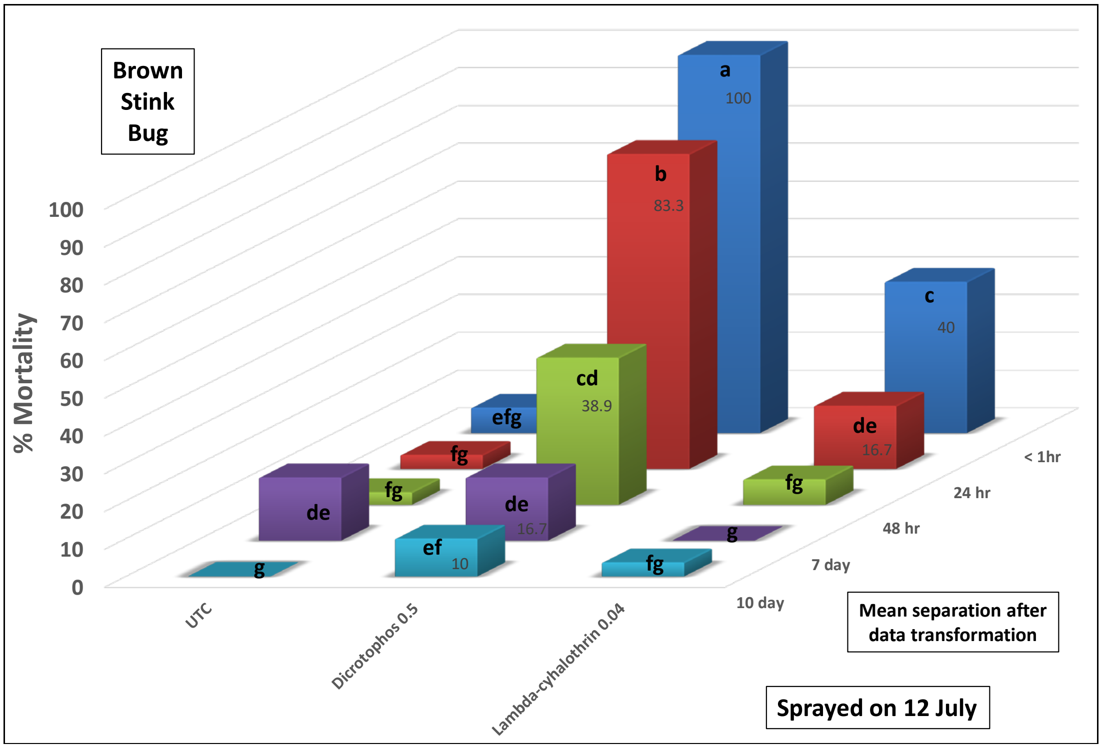

Figure 7. Mortality of brown stink bug (BSB) adults caged on cotton terminals (1-d exposure) after various post-treatment intervals (<1 hr. to 10 d) with dicrotophos (0.5 lb. ai/acre) or *lambda*-cyhalothrin (0.04 lb. ai/acre) and compared with an untreated control in Blackville, SC, during 2021.

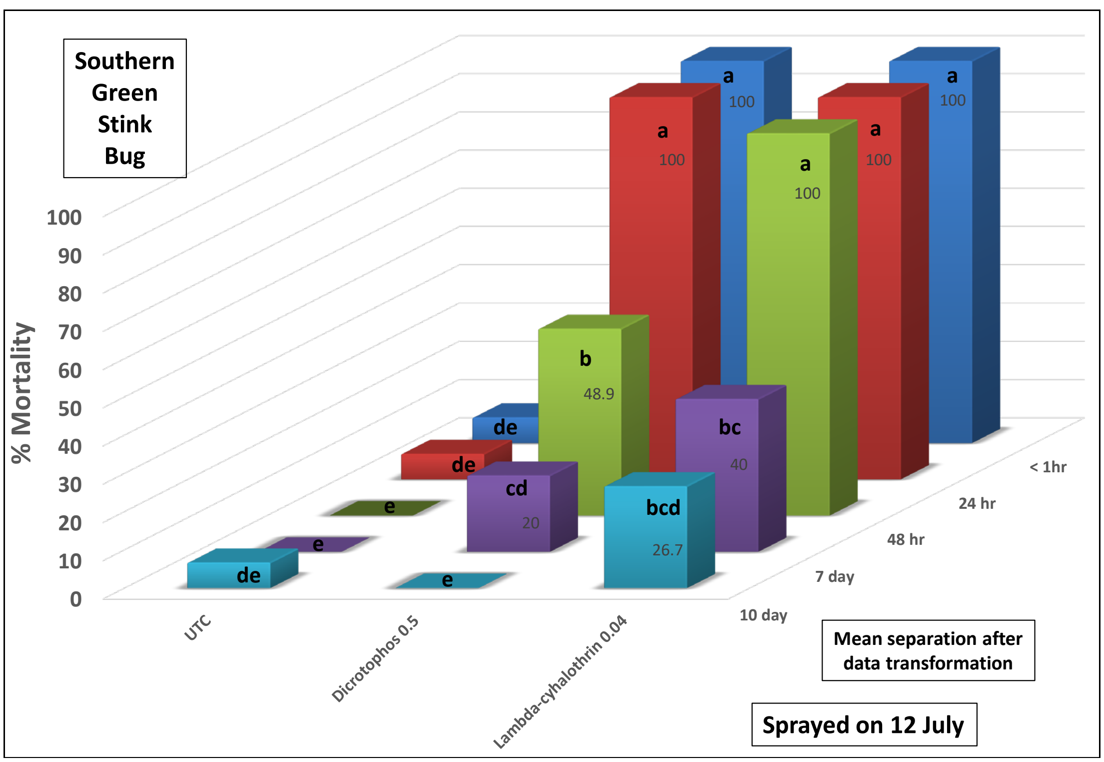

Figure 8. Mortality of southern green bug (SGSB) adults caged on cotton terminals (1-d exposure) after various post-treatment intervals (<1 hr. to 10 d) with dicrotophos (0.5 lb. ai/acre) or *lambda*-cyhalothrin (0.04 lb. ai/acre) and compared with an untreated control in Blackville, SC, during 2021.

Summary

Performance of insecticides was similar across a wide span of time (up to 13 years). Notably, bifenthrin was the most efficacious pyrethroid for control of BSB, consistent with previous reports (Greene et al. 2001, Willrich et al. 2003, Greene and Capps 2005, Snodgrass et al. 2005), with other pyrethroids (*lambda*-cyhalothrin, *zeta*-cypermethrin, and deltamethrin) providing fair-to-poor control of BSB but good extended control of SGSB. Mortality of LFB after exposure to pyrethroids or dicrotophos was similar to that observed with SGSB. Dicrotophos provided excellent initial control of all species (BSB, SGSB, LFB), but residual control was limited.

Acknowledgments

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