Final Project Report

Detection and Control of *Prosapia bicincta* (Two-line Spittlebug) in Hawaii

P.O. C81112

For the Period of
October 1, 2017 – April 30, 2019

Submitted by:
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This report covers the period from October 1, 2017 through April 30, 2019. The work describe herein was completed through multiple funding sources including this contract (HISC, C81112; $50,000), a contract with Hawaii County ($25,000) and the Hawaii Dept. of Agriculture (contract no. 65973; $300,000). Collectively, the objectives of the work under these three funding sources were to 1) provide rancher outreach and education; 2) conduct surveys to detect and monitor TLSB populations; 3) develope of Integrated Pest Management (IPM) protocols (Pesticides, Grazing management, Forage replacement); 4) conduct biological control agent exploration; and 5) research the biology and ecology of TLSB.

Two-lined spittlebug was first detected in Kailua-Kona, on the Big Island of Hawaii in September of 2016 where it had caused damage to nearly 2,000 acres of pasture land. Monthly pasture surveys that began in in November of 2017 have revealed that the pest has rapidly expanded its range and as of April 2019 infests over 197 sq. miles or about 125,915 acres. In highly infested areas, the TLSB has resulted in nearly 100% die back of key pasture grasses including Kikuyu (*Pennisetum clandestinum*) and pangola (*Digitaria eriantha*) grasses. The loss of these important livestock forages provides entry for the establishment of many undesirable, and often invasive plants including Pamakani (*Eupatorium adenophorum*), wild blackberry (*Rubus* spp.), fireweed (*Senecio madagascariensis*), Hilo grass (*Paspalum conjugatum*), several other minor grasses of low forage quality, and other weeds.

Rancher Outreach and Education

Rancher outreach and education has included the publication of a TLSB pest alert, and an update distributed through the Hawaii Cattlemen's Council (HCC) meetings and at CTAHR extension workshops. An educational workshop was held May 14, 2018 in Kona for cooperating producers, HDOA Plant Pest Control Branch personnel, and UH Faculty. Educational presentations were provided to ranchers across the state at the 2017 and 2018 HCC Annual meetings, and at the joint mid-year meeting of the HCC/Hawaii Cattlemen's Association meetings in June of 2017 and 2018. The TLSB team provided a field day/pasture walk training for USDA-NRCS field personnel on the identification and detection of TLSB in pastures. A poster on TLSB in Hawaii was presented at the 2019 Annual meeting of the Society for Range Management, and at the Ag Day at the Capital in February. Monthly reports of the survey data are compiled and provided to the cooperating ranches, and HDOA-Plant Pest Control Branch personnel.

Field Surveys

In October/November of 2017 the project team established five Two-line Spittlebug (TLSB) transects on each of two ranches in the North Kona area where the bug had been reported along an elevational gradient transcending from 2,000 to 5,000 ft. Spittlebug larva and adults were documented and collected from the transects. With funding, a recruitment for a Research Technician and two graduate students was initiated in October. One Graduate Student position was filled in early January 2018 and the research technician position was filled on January 17, 2018.

New transects were established on two additional ranches, one where spittlebug activity had been previously documented, and a second ranch further south, where no spittlebug activity was reported. Monthly surveys of all the transects on all four locations began in February 2018.

The addition of these two locations allowed us to bracket both the northern and southern extents of the Two-line spittlebug infestation by fall of 2018. Subsequent surveys, further north and south of our monitoring sites have not detected TLSB activity, nor have there been any reports of activity from ranchers outside of the current documented range of infestation. Thus, we believe that we now have both the northern and southern extents of the spittlebug population documented. However, without continued monitoring and specific steps to control the current infestation we expect the bug to continue to expand its range.

Ten 0.25 m^2 observation points are located at 10 m intervals along each100 m transect at each of the four monitoring sites. Data collected in 0.25 m^2 observation points include a count and collection of TLSB nymphs and adults; identification and count of the number of plant species present; an estimate of canopy cover and height by growth form (grass, forb, shrub), and an estimate of damage (grass dieback) by grass species. This data has allowed us to gain an understanding of the biology and ecology of TLSB in Hawaii (objective 5) in terms of habitat selection, live cycle, along with the impacts of the bug on the composition of plant species in Hawaii rangelands.

Integrated Pest Management Protocols

Work on this objective is still underway. Through our field observations and literature reviews of TLSB behavior elsewhere we have compiled a short preliminary list of Integrated pest management strategies for ranchers and homeowners. These are being compiled and will be published in extension documents in the future. Below is a summary of our preliminary IPM strategies for TLSB in pasture areas and for homeowners:

For ranchers with extensive areas infested grazing management strategies are the most cost effective, while reserving high dollar strategies for targeting critical areas or new (small) infestations. Grazing strategies include heavy grazing at the earliest detection to reduce suitable habitat for both the nymphs and adults followed by extended rest to allow for recovery of the forages. These intense grazing bouts may need to be repeated two or three times during the summer months (peak TLSB activity) until the bug goes into diapause (usually October/November). Pesticides are available for spittlebug control in pastures. Many are restricted use, but several are not. Due the cost and potential collateral damage of pesticides it is recommended that ranchers use pesticides strategically to target key use areas and/or where there new, small outbreaks of TLSB. Heavily damaged pastures should be seeded with one or more resistant varieties of forage grasses as soon as possible to help suppress competing weeds and recover forage quality of the pasture.

For home owners it is recommended to reduce watering as this will help dry out the underlying soil-bed reducing the suitability of the habitat of nymph survival. Additionally, the lawn should be kept short as this will reduce nymph and adult habitat. Non-restricted use pesticides can be used to spot treat observed nymph infestations.

Biological Control Agent Exploration

Working with a plant pathologist from the USDA-ARS laboratory in Hilo, Hawaii an indigenous predatory nematode has been identified that, thus far, under laboratory conditions will infect nymphs resulting in their death. The nematode is found along the beach strand at the transition between the beach sand to the upland soils. It is not clear if it is found at higher elevations. Initial field trials were conducted to determine if the nematode could be delivered either as a spray of a water-based solution or in the cadaver of wax month nymphs. The trials failed to produce any infected TLSB nymphs in the treatment plots in the field. However, we were able to detect the nematodes in soil samples collected from the plots several weeks later. Thus, the nematode holds promise as a locally derived biological control if we can determine an effective and economical method to deliver them to TLSB infestations.

Two-line Spittlebug Biology and Ecology

In addition to the data collected in the monthly surveys, laboratory/greenhouse studies provide critical evidence in the biology and ecology of the TLSB. Studies underway include host plant specificity trials, nymph survival trials on an array of grass species, and adult/nymph density threshold trials. As these trials are ongoing specific results are not available.

Summary of Expenditures

Expenditures (Total $49,998.54) of the $50,000 awarded by HISC to this project included:

Materials and Supplies: $29,845.82; this included materials and supplies for setting up greenhouse space for the various trials; laboratory supplies; office and field supplies; pesticide sprayers; and grass seed for host testing/reseeding affected pastures. This was $5,910.04 less than the original budgeted amount ($35,500), of which $3,750 was transferred to Salary and Wages, while the remainder $2,160.04 covered additional travel costs (see below), print and other expenditures (see below).

Salary and Wages (including Fringe): $3,589.96; though originally not budgeted we faced a shortfall in salary for our graduate student for the period of March 1 through April 30, 2019 while waiting for the NCE on our HDOA grant. We moved $3,750 to salary from Materials and Supplies to cover the salary gap.

Travel: $11,386.50; This exceeded our budgeted amount of $9,955.00. The travel funds were used transport the graduate student between Oahu and Kona, Hawaii during site survey weeks and to conduct greenhouse trials for her thesis.

Print: $150.88; covered the cost of printing a poster on the TLSB project for the Ag Day at the Legislature in February 2019.

Other Expenditures: $480.01; Included license fees for software used to support (ESRI, GoToMeeting, Adobe) the project objectives.

Indirect costs: $4,545.37; Indirect cost rate of 10%.

Appendix

Figure 1. Two-line Spittle Bug adult (top) and nymphs in spittle mass found along grass roots just below the soil surface. Both the adult and nymph feed on the xylem (nymphs) and phloem (Adults) of the plant. Adults inject amylase into the plant that interferes with photosynthesis resulting in leaf die-back and in severe cases, plant death.

Figure 2. Rangeland damaged by Two-Line Spittlebug in the mauka lands of Kailua-Kona. Two-line Spittlebug densities greater than 50 nymphs/m^2 consistently resulted in the dieback of Kikuyu and Pangola grasses (top) leading to the invasion of weeds such as Pamakani, fireweed, blackberry and many others (bottom).

Figure 3. Progression of a TLSB infestation from initial attack (left, June 2018) on healthy range grasses involving a small patch to all visible range infested (right, January 2019) with dieback of grasses and increasing weed infestation. Applications of pesticides and intensive grazing in the early stage of an infestation may reduce the degree of TLSB damage observed on the right.

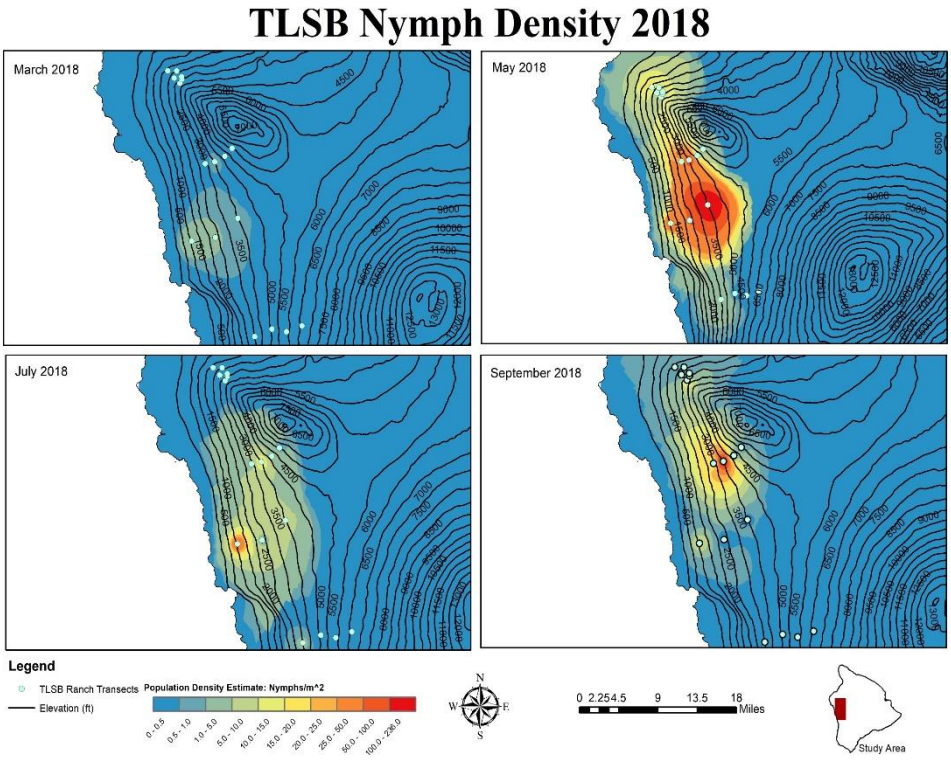

Figure 4. Map series showing the change in TLSB nymph densities between March and September of 2018. Note bimodal peak in densities (May and September). The pest entered diapause over the winters of 2017 and 2018.

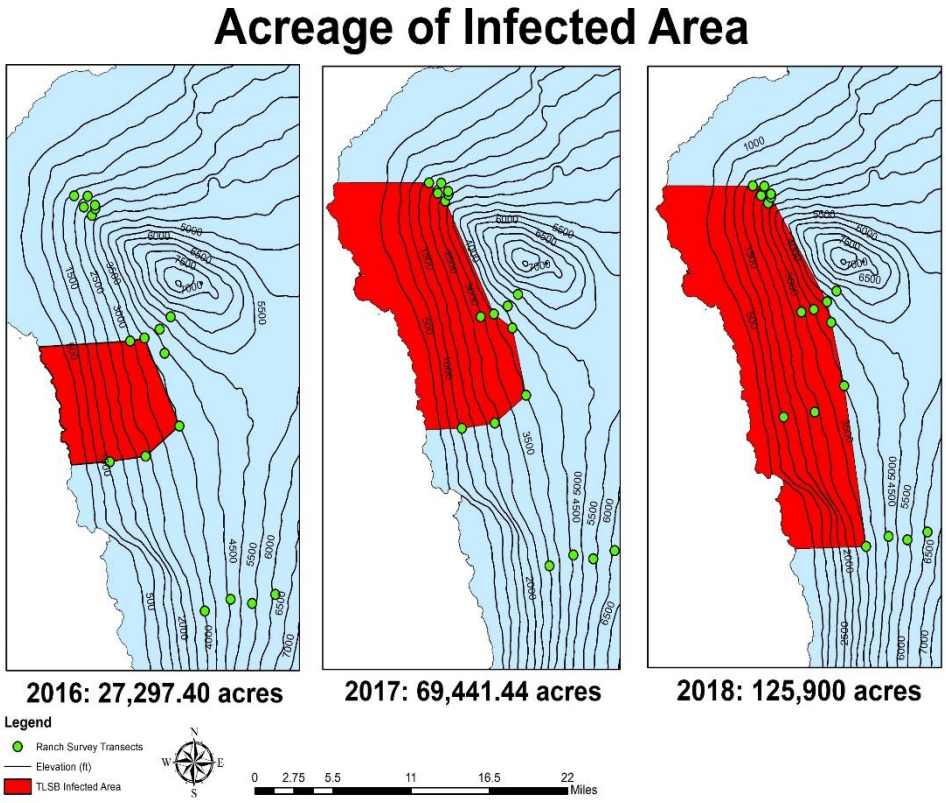

Figure 5. Map series depicting the expansion of Two-Line Spittle Bug in the Kailua-Kona region of Hawaii County between 2016, when it was first identified, and December of 2018.