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Evaluation of insecticides for the management of rough sweetpotato weevil, *Blosyrus asellus* (Coleoptera: Curculionidae) in Hawai‘i Island

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Introduction

Sweetpotato, *Ipomoea batatas* (Olivier), is an important staple food crop in Hawai‘i and critical to food security in these geographically isolated islands. In 2007, 76% of sweetpotatoes consumed in Hawai‘i were produced within the state (HDOA 2008). In addition to local consumption, it has developed into a major export crop with a total farm value of $7.3 million in 2011 (HDOA 2013). Sweetpotato production faces several challenges from diseases and insect pests, most recently from the rough sweetpotato weevil (RSW), *Blosyrus asellus* (Coleoptera: Curculionidae) (HDOA 2011) (Figure 1). This pest was first detected on a commercial sweetpotato farm on the island of O‘ahu in 2008, with subsequent detection on the island of Hawai‘i in 2014 (Heu et al. 2014). In contrast to other weevil pests of sweetpotato in Hawai‘i whose immature stages (grubs) feed inside the tuber, the grubs of rough sweetpotato weevils feed on tuber surfaces, severely damaging their appearance and reducing marketability.

Figure 1. Rough sweetpotato weevil (photo courtesy of Grant McQuate, USDA).

At present, this pest is not known to occur in the continental U.S., but the New Pest Advisory Group (NPAG) of USDA has identified several southern states under the risk of establishment. It is important to have a short-term strategy to control this insect, while further research is conducted on sustainable methods for management. We investigated efficacy of five insecticidal treatments that included four compounds (including one organic bioinsecticide) that were already approved for use against weevils in sweetpotato plus a control (no insecticide treatment for RSW).

Materials and methods

Cuttings of sweetpotato variety ‘Okinawan’ were planted on 1 April 2015 at Pepe‘ekeo, Hawai‘i Island, in a field with a history of past RSW infestation.

Each plot contained 30 cuttings spaced 1 foot (0.3 m) apart in 30-foot (9.1-m) planting beds spaced 5 feet (1.5 m) apart (Figure 2). The spacing is similar to the commercial production practices prevalent in the area. An outer border row was planted with the same variety surrounding the entire experimental area.

Agronomic practices including fertilizers and soil amendments recommended for sweetpotato cultivation were based on Valenzuela et al. (1994). Phosphorus was applied as triple superphosphate (analysis 0-46-0) in a band within a row at 200 lbs. P/acre. Nitrogen (N) and potassium (K) fertilizer (A-1, analysis 23-0-36, Brewer Environmental Industries, Hilo, HI) was applied at the rate of 100 lbs. N/ acre in split applications at approximately 15, 45, and 75 days after planting (DAP).

The five treatments were Belay 16 WSG (Clothianidin; Valent U.S.A. Corp., Walnut Creek, CA), Sevin XLR Plus (Carbaryl; Bayer CropScience, Research Triangle Park, NC), Provado 1.6 flowable insecticide (Imidacloprid; Bayer Crop Science), BotaniGard ES (*Beauveria bassiana* strain GHA; Laverlam International Corp., Butte, MT), and control. The five treatments were repeated four times in a randomized complete block design.

Belay was applied once before planting as a soil drench at the rate of 12 fl. oz./acre. Sevin was applied at the rate of 2 quarts/acre at 15, 45, 75, and 105 DAP. Provado was applied at the rate of 3.5 fl. oz. per application at 30, 60, and 90 DAP. BotaniGard, an organic bioinsecticide, was applied at the rate of 40 g/3 gal. of water per application as a soil drench on each 30-foot bed at 30, 60, and 90 DAP. All the treatments including control plots received 3 applications (at 30, 60, and 90 DAP) of Success insecticide (Spinosad; Dow AgroSciences, Indianapolis, IN) as foliar spray at the rate of 6 fl.oz./acre per application to control sweetpotato vine borer [*Omphisa anastomosalis* (Lepidoptera: Pyralidae)]. Water requirement for the sprayer to cover one bed was calibrated prior to the actual application of insecticides. The number of applications for each of the treatment compounds did not exceed the labeled rate.

A pre-harvest assessment of RSW infestation in treatment plots was done on 20 July 2015 by manually harvesting 3 plants from each bed and inspecting for characteristic feeding damage on tubers. The purpose of this sampling was to determine whether RSW injury occurred in this trial and the best time to harvest. Blocks A and B were mechanically harvested on 26 August 2015 and blocks C and D on 27 August 2015.

The harvested tubers were washed and

Figure 2. Agricultural technicians (left to right) Dayle Tsuha, Ryan Kaneko, Mary Kaheiki , and Eric Magno planting cuttings of variety 'Okinawan'.

Figure 3. A: low damage by rough sweetpotato weevil (RSW). B: medium damage by RSW. C: high damage by RSW.

graded based on the standards for Hawai'i-grown sweetpotatoes (Department of Agriculture, Division of Marketing and Consumer Services, Honolulu) regardless of RSW damage. These grades include Hawaii Fancy (Grade AA), Hawaii No.1 (Grade A), and Hawaii No.2 (Grade B). Tubers unmarketable according to these standards were included in Off-Grade. Tubers in each grade were closely examined for feeding damage by RSW and labelled as damaged or undamaged by RSW based on the presence or absence of feeding damage. Because of low yield in some grades and for meaningful statistical comparison, the first three grades were pooled into the "marketable" category.

Tubers with RSW damage were further grouped into three categories based on the extent of damage on each tuber. Tubers with inconspicuous damage were categorized as low damage (Figure 3A), tubers with visible but scattered feeding damage were categorized as medium damage (Figure 3B), and tubers with widespread damage were categorized as high damage (Figure 3C).

Analysis of variance was conducted using statistical software (PROC GLIMMIX, SAS version 9.3 for Windows; SAS Institute, Cary, NC). A probability value of or below 0.05 ($P \leq 0.05$) was considered to be statistically significant. LSMEAN statement was used to compare the means.

Results

The pre-harvest assessment of three plants per plot at 3.5 months after planting showed no damage in plots treated with Sevin or Belay. On average, 10.1% of tubers from control plots showed RSW damage. In plots treated with BotaniGard and Provado, 37.8% and 36.2% of tubers showed RSW damage, respectively. We did not conduct statistical analysis on these results due to small sample size.

After harvest at 4.5 months, the insecticidal treatments showed statistically significant differences ($P<0.01$) in percent of all damaged tubers. Plots treated with Sevin or Belay had a significantly lower percent of damaged tubers compared to the other three treatments (Figure 4). There were no significant differences between the Sevin and Belay treatments.

The other three treatments (Provado, BotaniGard, and control) had more than 40% of tubers affected by RSW. There were no significant differences among the control, Provado, and BotaniGard treatments (Figure 4).

Similar results were found when examining the percent of tubers damaged by RSW within

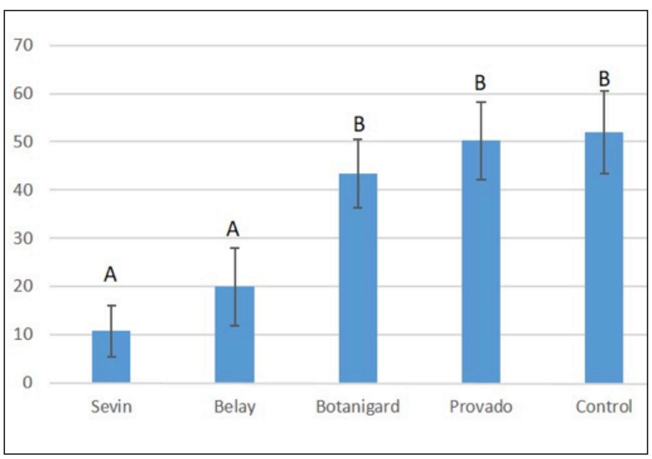

Figure 4. Percent of all tubers with characteristic damage caused by rough sweetpotato weevil (RSW) after treatment with four insecticides and a control. Bars denoted by same letters are not significantly different.

Table 1. Mean ± SE of percentage of tubers damaged by RSW based on the grade of tubers.

Treatment	RSW-damaged marketable tubers, %	RSW-damaged off-grade tubers, %
Sevin	10.6 ± 7.2¬¬A	10.8 ± 4.6A
Belay	26.2 ± 5.5A	5.4 ± 1.6A
BotaniGard	48.8 ± 9.5BC	31.2 ± 7.2B
Provado	56.8 ± 10.1C	30.2 ± 2.1B
Control	60.8 ± 10.1C	25.2 ± 6.3B

Note: Figures followed by the same letters are not significantly different.

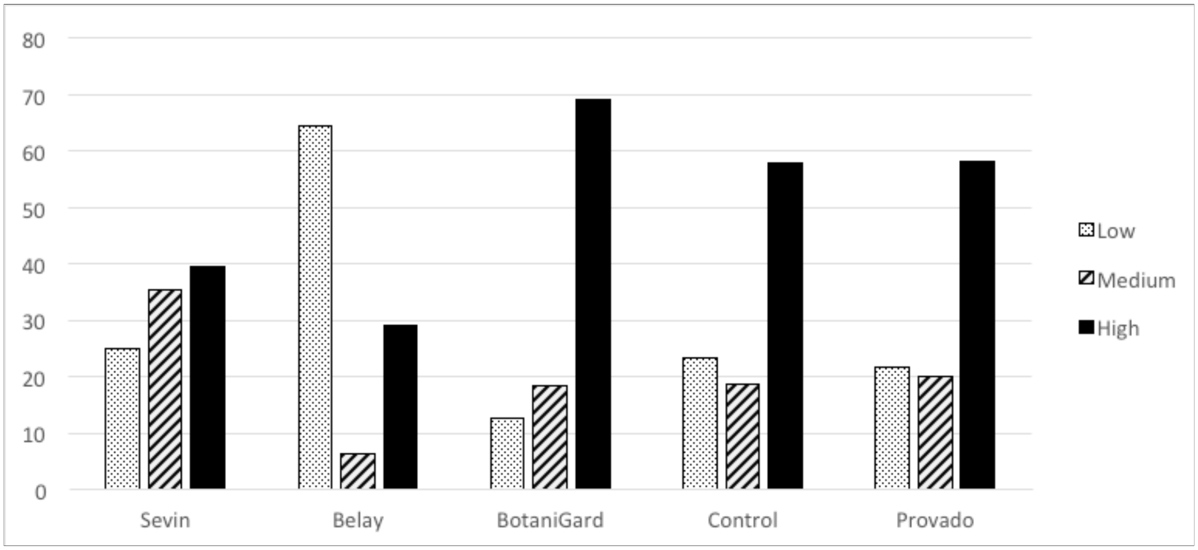

Figure 5. Percent of all tubers having low, medium, and high amounts of RSW damage under five treatments, based on visual assessment

grades (i.e., marketable or off-grade), with significant differences observed among treatments (*P*<0.01, *P*<0.01 respectively). Plots treated with Sevin or Belay had significantly lower incidence of damaged tubers (Table 1). The other three treatments had a much higher incidence of damage within those two grades and did not differ among these treatments.

Treatment blocks (i.e., location in field) had a significant influence on the percent of all damaged tubers (*P*<0.01). Blocks A and B had a significantly greater amount of damage (46.5 ±8.2% and 46.2±7.8% respectively), compared to blocks C and D (25.3±7.2% and 23.5±5.9% respectively). Blocks A and B were located closer to a nearby field of sweetpotatoes that had been harvested earlier and showed considerable infestation of RSW based on characteristic damage to tubers.

The severity of damage was assessed visually on each tuber (Figures 3, 5). These data were not statistically compared, because the number of tubers in these categories varied considerably. However, these data do provide an indication of the effectiveness of each treatment in controlling RSW. All other treatments besides Sevin and Belay had more than 55% of their tubers affected severely.

Overall, yields of 'Okinawan' sweetpotatoes in this trial were low because the harvest was performed early, not allowing for optimum yield. This early harvesting was done to avoid masking of the treatment effects by leaving the crop too long after final insecticide application. Fresh weight yields of tubers did not vary significantly based on the treatments.

Discussion

Sevin and Belay appear to be effective in controlling RSW through 4.5 months after planting. The duration of the effectiveness of Belay is uncertain, since it was applied once at planting, and harvesting of 'Okinawan' sweetpotatoes was conducted before most sweetpotatoes were marketable in size. Perhaps a combination of Belay application at planting followed by monthly applications of Sevin from 3 months after planting may be an effective method to control RSW. A second field trial has been initiated to confirm these results.

Sweetpotato growers need to remove unmarketable sweetpotatoes from their fields, as these tubers serve as a breeding ground for insect pests such as RSW. Another alternative might be to deep-plow fields after harvesting to bury unmarketable tubers.

Conclusions

Based on this first field trial, insecticides Sevin or Belay appear to be effective in controlling RSW. Growers might want to test these treatments to see if they are effective for RSW management under their conditions. Information in this report does not constitute a label replacement or a recommendation. Before applying any pesticide, applicators must determine if the product under consideration is correct for the intended use site. Always read the container/package label to determine if the intended use site is included on the label. READ AND FOLLOW LABEL INSTRUTIONS BEFORE PURCHASING AND USING ANY PESTICIDE PRODUCT.

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