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Management of Caterpillar Pests in Hawai'i Pastures

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Introduction

Periodic outbreaks of grass-feeding caterpillars may have devastating consequences for pasture productivity across the state. The intent of this document is to provide information on these pests, including what to look for and what you should do if you find these pests causing damage in your pastures.

2015 Infestation

During the week of September 14, 2015, there was a severe outbreak of lawn armyworm (*Spodoptera mauritia acronyctoides* Guenee) and grass webworm (*Herpetogramma licarsisalis* Walker) at the Mealani Research Station (Figure 1). Nearly a third of the station's paddocks were affected. Quick surveys and larval counts in several affected paddocks indicated caterpillar populations approaching 900,000 larvae per acre (counts exceeding 20 larvae per square foot). At dusk, large swarms of moths were observed in and around the Waimea area, especially along the highway between Kamuela and Honoka'a. The swarms of moths were an indication that a potentially large outbreak could occur within three to five weeks in these areas. Other ranchers also reported armyworm and grass webworm damage during this time in the mauka regions of Kohala, Kona, and Hāmākua. There was one report of caterpillar activity each on the islands of Kaua'i and Maui as well. To date, there has been no reported activity on Moloka'i or O'ahu. Livestock producers should be on the alert to potential damaging outbreaks in their pastures.

Pest Biology

Lawn armyworms have a life cycle of about 42 days from egg to adult (Deputy and Hara 2000). In lawn situations, the moths lay 600–700 eggs in felt-like masses on the leaves of trees and shrubs. The eggs hatch in about three days. Armyworm larvae progress through eight instars and reach about 1.5 inches in length after about 28 days (Tanada and Beardsley 1958). The larvae are most active

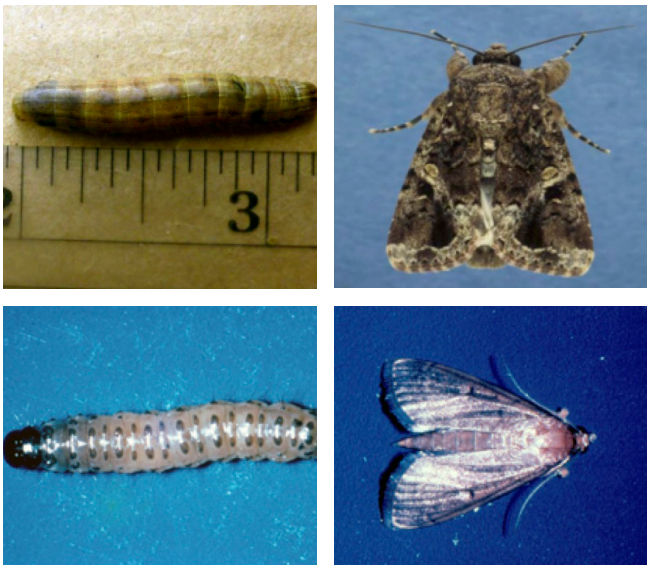

Figure 1. A. Lawn armyworm caterpillar. This specimen is 1.25 inches long, but they can grow to 1.5 inches in length. B. Armyworm moth (photo L. Turton). C. Grass webworm caterpillar (photo A. Hara). D. Grass webworm moth (photo A. Hara).

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at night and typically hide in the thatch and soil during the day (Figure 2). At the end of the final instar stage the larva will burrow into the soil and form a pupa that emerges in about 11 days as an adult moth.

Grass webworm moths lay their eggs in small clusters along the upper surface of leaves and stems, along the midrib near the base of the blade (Deputy and Hara 2000). The larvae hatch within four to six days at night. They progress through five instars over about a 14-day period and reach approximately one inch in the final stage. As with the armyworm, the larvae are active at night and will hide during the day in the soil and thatch (Figure 2). The fifth instar will burrow into the soil, pupate, and emerge as an adult moth in six to seven days. The adult moth will live for about 13 days, laying between 250 and 500 eggs.

Natural Enemies

These pasture pests are always around but usually in numbers that result in a tolerable level of damage. In most years they are controlled by insect diseases (bacteria, viruses, fungi) and other natural enemies, such as tiny wasp-like parasites and various predators (Tanada 1966, Deputy and Hara 2000). Parasites include a *Trichogrammatid* wasp, which attacks the egg stage of the caterpillar. Predators of these pests include ants, beetles, toads, and certain species of birds, including cattle egrets, mynah birds, and several other birds that feed on caterpillars and adult moths. Usually these natural enemies occur in sufficient numbers to effectively control the populations of these pests (Deputy and Hara 2000).

Figure 2. Armyworm and grass webworm in soil during the day in a kikuyugrass pasture at the Mealani Research Station.

In most years damage to pastures by lawn armyworm and grass webworm is usually spotty and minor; it is probably not even recognized, as the "background" populations of these pests are kept low by their natural enemies. However, as with the Mealani infestation in 2015, large breakouts can occur from time to time. The combination of hot, humid weather and abundant forage production allowed the pest populations to multiply beyond the capacity of their natural enemies to regulate them. Historically, occasional large outbreaks of armyworm and grass webworm have been documented in Hawai'i. For example, Davis (1955) reported on an outbreak that caused damage to an estimated 50,000 acres of pastureland on ranches stretching from the Kā'ū district to the Kohala district. Other outbreaks occurred in 1961–1962 (Tanada 1966; P. von Holt and M. Richards, personal communication), affecting pastures in Kohala, and in the mid-1980s, affecting pastures and young sugarcane in Hāmākua (T. Young, personal communication).

Pasture Assessment

Damage to pastures by early instar stages of lawn armyworm and grass webworm is usually minor and not easily recognized. Pastures will appear to be slow to recover following grazing and may have small patches of slow growth with little dead material visible. As the larvae mature, they consume more and more of the grass, beginning with the leaf blades at the base of the plant and progressing up the stem to the top. The final instar stages consume the most plant material, and it is at this stage that damage to the pasture is most readily identified (Figure 3). Pastures where the larvae have matured into the final instars will display large patches with only stem material remaining (or with few top leaves). This stem material will be covered in frass (dried caterpillar feces), and remaining leaves will have ragged edges as a result of the caterpillar chewing damage (Figure 4). There may be an advancing edge to the damage as the larvae move through and into adjacent pasture (Figure 3). This may appear as fairly distinct zones between the brown, damaged grass and the undamaged green grass. High densities of actively feeding caterpillars may be found at this juncture.

Scout Pastures

Because lawn armyworm and grass webworms can be so destructive and compete with livestock for forage, it is important that producers diligently scout for these pests, beginning in late spring and continuing through early fall. It is best to begin scouting pastures at the first signs of an infestation, such as dead patches of grass or pastures that are not recovering as quickly as they should. Scout pastures by looking for areas that show signs of damage by armyworm and/or grass webworm. Check areas of dead grass and places where birds (cattle egrets, mynah birds, etc.) are feeding as possible locations for lawn armyworm and grass webworm. The larvae of lawn armyworm and grass webworm are primarily active at night. Thus, if scouting during the day, you will need to dig into the thatch around the base of the plants to find the larvae (Figure 2). Also look for other evidence of caterpillar activity, such as chewed grass leaves and caterpillar droppings (Figure 4). Look for larvae at the soil surface just under the thatch, moths that rise out of the grass as you walk through, and eggs near light sources for armyworm, and at the base of leaf blades and on the top side of grass leaves for grass webworm. Look for brown patches, or irregular patches of dead or chewed grass with fecal droppings (frass) attached. Look for threads of webbing clinging to chewed grass. In 10 or more random samples, count the number of larvae found within a square foot. Record date, count, and approximate size of larvae in each square foot observed. Assess the extent of infestation (number of larvae in sq. ft. x 43,560 sq. ft./acre yields number of larvae per acre). A frame constructed from ½-inch PVC pipe that covers a one-square-foot area can make sampling easier. Once the sampling frame is dropped in a random location, examine grass blades, stems, plant bases, and thatch for larvae. Record the date, the approximate area damaged (i.e., 100 sq. ft., 2 acres, 20% of pasture, etc.), and the number and approximate size of the caterpillars found within the one-square-foot perimeter. Diluted dishwashing detergent (2 tablespoons per gallon of water) can be used to drive the larvae out of the thatch. Also, infestations occur in waves approximately one month apart. Scouting should occur

Figure 3. Armyworm- and grass webworm-damaged pasture at Mealani Research Station 09/18/2015. Top picture taken along leading edge of caterpillar advance from left to right. The green line shows limit of advance, while the red arrow shows direction of advance. Bottom picture is a close-up of caterpillar damage to kikuyugrass in the same paddock.

Figure 4. Kikuyugrass showing signs of caterpillar damage, including chewed leaf blades and fecal pellets (frass).

no more than two weeks after the initial infestation, with follow-up scouts every two weeks thereafter until the counts fall below 1–2 larvae per square foot.

Assess Damage

Assess damage to pasture as a percentage of total area (i.e., 10%, 20%, etc.) and estimate the amount of acreage affected. Evaluate remaining pasture for ability to support herd for up to 18 weeks as affected acreage recovers from damage. Do this by quantifying forage availability and calculating a stocking rate in remaining, unaffected acreage (Thorne and Stevenson 2007). Scout ahead in remaining acreage for potential impact by lawn armyworm and/or grass webworm.

Integrated Pest Management Options

When considering adopting measures to control lawn armyworm and grass webworm, it is important to properly assess the population of these pests in your pastures and their degree of impact in order to distinguish between what is considered an acceptable "background" population with minimal impact and what is an "outbreak" population with a potential for identifiable economic consequences. Where the damage threatens sustainability of the pastures and the economic stability of the ranch, it is recommended that affected operations invest in insecticide treatments. In general, a reasonable threshold for insecticide treatment occurs when four or more larvae per square foot are present. Table 1 provides the total number of larvae expected in successive generations for initial larval counts of one, two, four, and five per square foot, assuming 50% survival to pupae, 50% female moths, and 375 successful eggs laid per female. This table demonstrates that in as little as 43 days, in the second generation, there can be over 16 million larvae emerging from an initial count of four larvae per square foot (174,240 larvae per acre).

Insecticide Treatment

Since insecticide treatment can be expensive, the costs and benefits of treatment vs. no treatment should be carefully assessed. Where infestations are severe (> 4 larvae/sq. ft.), strategic applications of insecticide would be economically viable. Treatment of affected pastures should be determined based on ability of unaffected pastures to sustain grazing of herd while damaged pastures recover. If unaffected acreage is sufficient to sustain grazing while affected acreage recovers, then insecticide treatment may not be necessary, though it should remain an option should an infestation develop into an acute situation. On the other hand, if the unaffected acreage is not sufficient to sustain the herd, then insecticide treatment is recommended and should begin as soon as possible. Treatment should be strategic, focusing on high-impact areas first such as the leading edge of caterpillar advance, new outbreaks, and places where infestations are the heaviest. It is important to follow label directions of selected insecticide for application rates, timing, grazing intervals, and resistance management (limits to reapplication frequency). The insecticide

Table 1. Exponential growth potential of lawn armyworm and grass webworm for successive generations following an initial count of 1, 2, 4, and 5 larvae per square foot. Counts are extrapolated to larvae per acre (count x 43,560 sq. ft. per acre), with successive generations assuming 50% mortality, 50% female, and 375 successful eggs laid per female.

Generation	No. of larvae			
	1/ft^2	2/ft^2	4/ft^2	5/ft^2
Initial	43,560/acre	87,120/acre	174,240/acre	21,7800/acre
2nd	4,083,750/acre	8,167,500/acre	16,335,000/acre	20,418,750/acre
3rd	382,851,563/acre	765,703,125/acre	1,531,406,250/acre	1,914,257,813/acre
4th	35,892,333,984/acre	71,784,667,969/acre	143,569,335,938/acre	179,461,669,922/acre

treatment should be used in conjunction with a sound grazing management plan.

Some of the considerations for the selection of insecticide to apply include 1) whether it is labeled for the intended use and licensed for distribution and sale in the state of Hawai'i (it is illegal to apply it if it is not so labeled), 2) the minimum days from last application to grazing, 3) other label restrictions, 4) the effectiveness of the insecticide, 5) the treatment cost, 6) the kind of personal protection equipment (PPE) required to apply the insecticide, and 7) how the insecticide may affect natural enemies of the target pest and other pests of pastures. Good spray coverage is important for obtaining control with insecticide applications. Properly maintained and calibrated application equipment and a high-quality spray adjuvant (surfactant) will help to produce good spray coverage. Table 2 provides information about some insecticides that are approved for caterpillar control in Hawai'i pastures.

Grazing Management

In addition to insecticides, high-density grazing during the initial pest attack is a management tool that can be used to minimize the overall impact of the caterpillars (Figure 5). Affected operations should adopt a grazing management strategy that utilizes their livestock as a tool to minimize losses in acreage to the lawn armyworm and grass webworm while at the same time maintaining the economic stability of the ranch in the face of potential crisis. In the first instance, high-density grazing applied

Table 2. Some insecticides approved for the control of caterpillars in Hawai'i pastures.

Insecticide and (Formulation)	Rate[1]	Signal Word/Use Restrictions[3]	Minimum Days from Last Application to Grazing	Comments
Carbaryl[2] (Sevin 4F)	1–1.5 quarts/acre	Caution	14 (harvest or grazing)	
Bacillus thuringiensis subsp. *Kurstaki* (DiPel ES)	1–2 pints/acre	Caution	0	Do not graze until foliage has dried
Methoxyfenozide (Intrepid 2F)	4–8 fl. oz/acre (0.06–0.12 lb ai/acre	Caution	0	Use higher rate for heavy infestations. Larvae stop feeding almost immediately but may take several days to die.
Rynaxpyr (Coragen)	3.5–5.0 fl oz/acre (0.045–0.065 lb ai/ acre)	No signal word	0	Larvae become paralyzed soon after ingesting foliage and die in 1–3 days
Spinosad[2] (Entrust[4]) (Success)	0.63–1.25 fl oz/acre 2–4 fl oz/acre	Caution	0	Do not graze until foliage has dried. Use higher rate for heavy infestations.

[1]Amounts listed are for the formulated product, unless otherwise indicated by ai, which is the amount of active ingredient per acre.
[2]Other products containing this active ingredient may be available.
[3]Signal words describe the acute (short-term) toxicity of the product. Products with no signal word or with the word "caution" are the lowest toxicity.
[4]Entrust is formulated for organic agricultural production.

Figure 5. High-density grazing (23 head/acre) on pasture affected by lawn armyworm and grass webworm at the Mealani Experiment Station, October 2, 2015. Note cattle egrets (white specks) feeding on caterpillars in pasture.

in the early stages of an outbreak will remove forage, trample larvae and pupae, and deny habitat for adults to lay eggs. Temporarily subdividing large pastures with electric fencing may be necessary to get the desired impact. However, this strategy must be used judiciously. Once the desired grazing impact has been accomplished, or in places where pastures were totally lost to the worms, further grazing should be delayed to allow for recovery of the forages. The recovery (rest) period will vary depending on conditions (extent of damage, pest population, soil fertility, precipitation, etc.) but should be long enough to allow for full vigor of the pasture to return. Severely damaged pasture may take between 12 and 18 weeks to recover once the pest populations return to normal. Grazing and sufficient rest do not guarantee that there will not be a subsequent outbreak of these pests in the same acreage. Consequently producers should remain diligent and continue to scout pastures for larvae.

Monitoring

Careful evaluation of all pastures should be made 1) to determine the degree of damage and potential for infestation to spread among all pastures, 2) to gauge the ability of unaffected pastures to carry the herd while affected pastures recover, and 3) to balance the stocking rate so that forage demand does not exceed forage resources (Thorne and Stevenson 2007). If it is determined that the unaffected acreage cannot support sustained grazing operations, additional steps may be necessary to prevent adverse impacts to the forage base. These measures might include early weaning of calves to dry up cows and reduce forage demand; culling old, unproductive cows to reduce demand for pasture resources; and other destocking measures if forage resources do not meet demand.

Summary

Severe outbreaks of lawn armyworms and grass webworms have occurred and will continue to occur from time to time in Hawai'i. These outbreaks can be devastating to individual ranches, as the larvae can compete with livestock for forage. Producers are advised to scout pastures for signs of damage by these pests beginning in the late spring and continuing through the fall. Scouting should include a count of larvae per square foot to assess the extent of the infestation. If an outbreak is detected, strategic high-density grazing may be useful in minimizing the impact through trampling of larvae and removal of forage, which denies food for the larvae and habitat for laying eggs. When larval counts reach or exceed four per square foot, investment in an insecticide treatment protocol may be economically feasible. Application of insecticides should be strategic, focusing on high-impact areas first such as the leading edge of caterpillar advance, new outbreaks, and places where infestations are the heaviest. Producers should continue to monitor their pastures following treatment, scouting for further outbreaks, checking on recovery of the forage, and assessing whether unaffected pastures can support the herd while affected pastures recover. Producers are encouraged to contact their local Extension office for additional information and assistance.

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Disclaimer

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 INSTRUCTIONS BEFORE PURCHASING AND USING ANY PESTICIDE PRODUCT—THE LABEL IS THE LAW!