Veronicellidae spp.

*Portions of this document were taken directly from the New Pest Response Guidelines for Tropical Terrestrial Gastropods (USDA-APHIS, 2010a).

Scientific Name

Laevicaulis alte (Férussac)
Sarasinula plebeia (Fischer)
Veronicella cubensis (Pfeiffer)
Veronicella sloanei (Cuvier)

Common Names

Laevicaulis alte: Tropical leatherleaf, lined leatherback slug
Sarasinula plebeia: Caribbean leatherleaf slug, bean slug
Veronicella cubensis: Cuban slug
Veronicella sloanei: Pancake slug

Type of Pest

Mollusk

Taxonomic Position

Class: Gastropoda, **Order**: Systellommatophora, **Family**: Veronicellidae

Reason for Inclusion

CAPS Target: AHP Prioritized Pest List for FY 2011

Pest Description

Veronicellidae are anatomically distinct from many other terrestrial slugs in that they have a posterior anus, eyes on contractile tentacles and no pulmonate lung. The sensory tentacles are bilobed (Runham and Hunter, 1970).

Veronicellidae “have a large mantle, which contains no shell, covering the entire back. The foot is transversely grooved and is separated from the rest of the body by a groove. The sides of the mantle (hyponota) are separated from the rounded back by a sharp ridge, the perinotum” (Runham and Hunter, 1970).

“The anus and pneumostone open below the hyponotum behind the foot. The male genital opening is on the right side of the body, in the groove separating the foot from the mouth, and the female opening is towards the middle of the hyponotum. The radular teeth are unicuspid, decreasing in size from the centre towards the edges. There is a curved jaw made up of numerous, small parallel plates. The nervous system is concentrated” (Runham and Hunter, 1970).

Although this family is fairly easy to tell apart from others, species within this family can be difficult to distinguish due to similar morphologies between species and multiple color variations within a single species. Taxonomy is based on the

morphology of the hermaphroditic reproductive system. Positive identification should be completed by a qualified specialist that is knowledgeable of the target species.

Laevicaulis alte

Description—Most specimens are grayish in color with a thin, pale brown longitudinal line down the dorsal side (Herbert and Kilburn, 2004). Extended length can be up to 12 cm (Herbert and Kilburn, 2004). *Laevicaulis alte* is very similar to *Laevicaulis natalensis* (Krauss) (Herbert and Kilburn, 2004).

Figure 1. *Sarasinula plebeia* (Image courtesy of Frank Peairs, Colorado State University, Bugwood.org)

Sarasinula plebeia

Description—*Sarasinula plebeia* has a grey notum with randomly placed minute dark marks weighing an average of 3 grams (Rueda et al., 2002). The foot is narrower than the hyponotum (Rueda et al., 2002). *Sarasinula plebeia* is externally similar to *Diplosolenodes occidentalis* (Guilding) (Walls, 2009).

Veronicella cubensis

Description—*Veronicella cubensis* can be variable in color ranging in shades of brown although albino versions exist. Some have two dark bands running down the dorsal side. They may also have a lighter stripe down the midline of the dorsal side. The adult is approximately 50-70 mm long (von Ellenrieder, 2004) but can reach up to 120 mm (McDonnell et al., 2009). The pneumostome of the slug opens on the underside of the mantle, behind the foot (von Ellenrieder, 2004). This species may be confused with the bean slug (*Sarasinula plebeia*).

Figure 2. *Veronicella cubensis* (Pfeiffer), (Image courtesy of David Robinson, USDA-APHIS-PPQ)

Veronicella sloanei

Description—Extended length is approximately 12 cm (Stange, 2006). Coloration can be highly variable but is usually a pale yellow, cream or white; slugs may have black spots on the dorsal side that may form two poorly defined longitudinal bands (Stange, 2006). Bands are usually better defined and grey in color in juveniles (Stange, 2006). The eyestalks are a constant bluish-grey with a

light brown tip (Stange, 2006). This characteristic is found only in this species of Veronicellidae making it easy to distinguish from similar species (Robinson et al., 2009).

Figure 3. *Veronicella sloanei* (Cuvier), (Image courtesy of David Robinson, USDA-APHIS-PPQ)

Biology and Ecology:

Laevicaulis alte

Laevicaulis alte is thought to be of African origin (Cowie, 2000). *L. alte* has shown two distinct feeding peaks, both in the early and late hours of the night (Raut and Panigrahi, 1990).

Herbert and Kilburn (2004) state that *L. alte* eggs are deposited in a hole or depression in the soil a few days after mating; the eggs are joined together by an interconnecting thread forming a string that the parent shapes into a ball-like mass. The parent then deposits special fecal pellets on the top of the eggs that contain high concentrations of soil which help maintain high humidity levels. Eggs are oval and translucent, measuring 6-8 mm in length and laid in batches of up to 100. Hatching occurs around 1-3 weeks with newborn slugs measuring around 7-8 mm in length. Maturity can be reached in as soon as five months, but breeding only occurs during favorable conditions. In India, *L. alte* breeds during monsoon season, while South African populations breed in the warm, rainy summer months (Herbert and Kilburn, 2004).

Sarasinula plebeia

Rueda et al. (2002) state that *Sarasinula plebeia* is a nocturnal slug that prefers disturbed habitats including backyards, gardens, and cultivated areas. This slug is oviparous with clutches averaging 37 eggs. The slugs lay one to two clutches per year but can have as many as four. In laboratory conditions, the slugs mature by around 6 months. Self-fertilization is common in this slug. In previous laboratory studies, *S. plebeia* was found to copulate several times in the same night that maturity was reached, suggesting a sexual pheromone may be released once slugs have matured sexually (Rueda et al., 2002).

Veronicella cubensis

Veronicella cubensis is nocturnal and usually found near water bodies or moist soil (von Ellenrieder, 2004). On Rota, this pest is found in almost all habitats ranging from undisturbed natural habitats to agricultural areas (Robinson and Hollingsworth, 2004).

Veronicella sloanei
Veronicella sloanei is nocturnal. It was found in both lab and field conditions to mate in pairs, triplets, or groups (Clarke and Fields, 2005).

Symptoms/Signs

Due to their apparent lack of host specificity, few reports as to specific damage caused by Veronicellidae species to agriculture have been published in the malacological or agricultural literature.

Laevicaulis alte
Laevicaulis alte is considered a serious agricultural pest in India where it is invasive (Herbert and Kilburn, 2004). Hosts include lettuce, spinach, and coriander (Raut and Panigrahi, 1990) as well as tobacco (Godan, 1983). It is also an intermediate host to the larval stages of some nematode parasites of vertebrates (dog, cat, and rat lungworms) (Herbert and Kilburn, 2004).

Sarasinula plebeia
In many Central American regions, *Sarasinula plebeia* is considered the most important bean crop pest. It has also become a pest on sweet pepper and tomatoes in Panama and cucurbits in Nicaragua (Rueda et al. 2002). It is considered a pest in Saipan where it causes feeding damage to white radish, red taro, Chinese cabbage, and pechay (Robinson and Hollingsworth, 2004). This species can become very abundant and serve as a public nuisance in both urban and suburban areas (Cowie et al., 2009).

Veronicella cubensis
In Hawaii, Rota, and Guam, *Veronicella cubensis* is considered an agricultural and horticultural pest (McDonnell et al., 2009). *Veronicella cubensis* can damage plants it feeds on including many ornamental and agricultural plants like banana, cabbage, cassava, citrus, coffee, eggplant, mango, noni, papaya, pepper, pumpkin, star fruit, sweet potato, taro, and yam (USDA, 2006). Like *S. plebeia*, this species can become very abundant and serve as a public nuisance in both urban and suburban areas (Cowie et al., 2009).

Veronicella sloanei
In Barbados, *Veronicella sloanei* is an important garden and plant nursery pest (Clarke and Fields, 2005). *V. sloanei* attacks many agricultural and horticultural crops including various beans, banana, *Brassica* cultivars (e.g., broccoli, cabbage, cauliflower), carrot, citrus, dasheen, eddo, eggplant, lettuce, peanut, peas, hot and sweet peppers, plantain, sweet potato, tannia, tomato, and yam (Stange, 2006). *V. sloanei* causes leaf damage and can also debark portions of plant stems on *Datura* and gardenia; *Hibiscus* and *Bougainvillea* can also be attacked by this pest (Fields and Robinson, 2004) as well as orchids (Godan, 1983). This slug is considered an important pest in the Caribbean (Fields and Robinson, 2004).

Pest Importance

These species can cause damage by feeding on agricultural and horticultural crops as well as native plants, thereby lowering crop yield and quality. Veronicellidae species can also transmit pathogens to humans indirectly when they consume vegetables and fruits that have been contaminated with mucus and feces. The slugs can also transmit pathogens to plants and livestock. Displacement of native mollusk species may also occur (USDA-APHIS, 2010a).

Known Hosts

These species are polyphagous, eating many different plants, organic material, and detritus (USDA-APHIS, 2010a).

Hosts specifically mentioned for each pest are listed below (lists are not meant to be all inclusive):

Laevicaulis alte

The following were experimental hosts from Raut and Panigrahi (1990):

Amaranthus gangeticus (Joseph's-coat), *Basella rubra* (Indian-spinach), *Brassica nigra* (black mustard), *Coriandrum sativum* (coriander), *Lablab purpureus* (lablab bean), *Lactuca sativa* (lettuce), *Lagenaria vulgaris* (bottle gourd), *Spinacia oleracea* (spinach).

Godan (1983) lists *L. alte* as a pest of *Nicotiana tabacum* (tobacco).

Sarasinula plebeia

Borreria spp. (borreria), *Brassica oleracea* (Broccoli, cabbage), *Capsicum annuum* (sweet pepper), *Cucurbita* spp. (squash), *Ipomoea batatas* (sweet potato), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Phaseolus* spp. (bean), *Phaseolus vulgaris* (bean), *Solanum tuberosum* (potato) (Sannazzaro et al., 2000; Rueda et al, 2002; CABI, 2007; Naranjo-Garćia et al., 2007).

Veronicella cubensis

Annona muricata (sour sop), *Artocarpus altilis* (breadfruit), *Averrhoa bilimbi* (pickle tree), *Averrhoa carambola* (star fruit), *Brassica* spp. (cabbage), *Brassica oleracea* (cabbage), *Brugmansia* spp. (angel trumpet), *Capsicum* spp. (pepper), *Carica papaya* (papaya), *Cecropia peltata* (trumpet-tree), *Citrus* spp. (citrus), *Coffea* spp. (coffee), *Colocasia* spp. (taro), *Colocasia esculenta* (taro), *Crotalaria retusa* (rattlebox), *Cucumis* spp. L. (Melon), *Cucurbita* spp. (pumpkin), *Dioscorea* spp. (yam), *Eulophia alta* (wild coco), *Eupatorium odoratum* (bitterbush), *Euphorbia cyathophora* (Mexican fire plant), *Hibiscus* spp. (hibiscus), *Ipomoea batatas* (sweet potato), *Lactuca* spp. (lettuce), *Lantana camara* (lantana), *Mangifera indica* (mango), *Manihot esculenta* (cassava), *Mentha spicata* (spearmint), *Miconia* spp. (johnnyberry), *Mikania micrantha* (bittervine), *Mimosa pudica* (action plant), *Morinda citrifolia* (noni), *Musa* spp. (banana), *Nephrolepis*

biserrata (giant sword fern), *Nephrolepis multiflora* (Asian sword fern), *Ocimum basilicum* (basil), *Paspalum* spp. (crowngrass), *Passiflora* spp. (passionfruit), *Peperomia meriannensis* (pot popot), *Philodendron* spp. (philodendron), *Piper aduncum* (spiked pepper), *Pipturus albidus* (mamaki), *Pteridium* spp. (brackenfern), *Sida rhombifolia* (Cuban-jute), *Solanum melongena* (eggplant), *Spermacoce laevis* (buttonplant), *Tacca leontopetaloides* (Polynesian arrowroot), *Thunbergia* spp. (thunbergia), *Trimezia* spp. (trimezia), *Urena lobata* (aramina), *Veronia* spp., *Veronia* cinerea (little ironweed), *Vinca* spp. (periwinkle) (Maceira, 2002; Robinson and Hollingsworth, 2004, Hollingsworth, 2008; NMC-CREES, 2009).

Veronicella sloanei
Arachis spp. (peanut), *Bougainvillea* spp. (bougainvillea), *Brassica oleracea* (broccoli, cabbage, cauliflower), *Carica papaya* (papaya), *Citrus* (citrus), *Colocasia esculenta* (dasheen, eddo), *Datura* spp. (Datura), *Daucus carota* (carrot), *Dioscorea* spp. (yam), *Gardenia* spp. (Gardenia), *Hibiscus* spp. (hibiscus), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Musa* spp. (banana), *Phaseolus* spp. (bean), *Piper* spp. (pepper), *Plantago* spp. (plantain), *Pisum* spp. (pea), *Solanum melongena* (eggplant), *Spinacia oleracea* (spinach), *Xanthosoma* spp. (tannia) (Stange, 2006; Fields and Robinson, 2004).

Known Vectors (or associated organisms)
Species of this family have been found to carry several nematode parasites, including *Angiostrongylus cantonensis* (rat lungworm), *A. costaricensis*, and *A. malaysiensis*. *A. cantonensis* can cause symptoms similar to meningitis in humans including headache, stiff neck, tingling or painful feelings in the skin, low-grade fever, nausea, and vomiting (USDA-APHIS, 2010a).

Known Distribution
This family is widely distributed in tropical regions of South America, southern Asia, Africa, Madagascar, and Indian Ocean Islands (Herbert and Kilburn, 2004).

Laevicaulis alte
Australia, Bermuda Islands, China, Fiji, India, Indonesia, Malawi, Malaysia, Midway, New Guinea, New Caledonia, Philippines, South Africa, Sri Lanka, Taiwan, Tanzania, Torres Islands, Vanuatu, Western Samoa, Zaire (Gomes and Thomé, 2004).

Sarasinula plebeia
Australia, Fiji, Hawaii, Toba, Indonesia, Marianas, New Caledonia, Philippines, Solomon Islands, Tahiti, Tuamotu, Vanuatu, Western Samoa (Gomes and Thomé, 2004). Belize, El Salvador, Honduras, Mexico, Nicaragua, Panama (Rueda et al., 2002) Canouan, Jamaica, Dominica (Robinson et al., 2009), Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Guatemala, St. Lucia, Puerto Rico, Venezuela, Virgin Islands (Thomé et al., 1997). Galapagos Islands

(Coppois, 2000), New Zealand (Evans et al., 1997), Madagascar and Comoros (Thomé, 2008).

Veronicella cubensis
This pest may have originated in Cuba but it is now present in Antigua, the Bahamas, Barbados, Dominica, Dominican Republic, Guam, Haiti, Hawaii, Rota, Jamaica, the Northern Mariana Islands, Olosega (Manu'a Islands), Pohnpei (Micronesia), Puerto Rico, St. Croix, St. Kitts and Nevis and Tutuila (American Samoa) (McDonnell et al., 2009).

Veronicella sloanei
Barbados, Bermuda, Dominica, Dominican Republic, Jamaica, St. Lucia and St. Vincent (Stange, 2006), Bahamas, Cayman Islands, Colombia, Honduras, Nicaragua (Thompson, 2008), Cuba (Maceira, 2003) and Guadeloupe (Robinson et al., 2009).

Potential Distribution within the United States

No risk documents exist for any of the tropical terrestrial gastropods that give potential distribution in the United States. Host material is unlikely to limit their distribution since they are all polyphagous, but these species are limited by climate. If introduced, the tropical terrestrial gastropods would most likely be limited to the southern part of the United States and possibly the West Coast where the climate is similar to native ranges. This is supported by detections of these species which have all been in either the southern United States or West Coast (USDA-APHIS, 2010a).

Laevicaulis alte
This species has been established in Hawaii since 1900 (Bishop Museum, 1999). It was also reported from Texas but may have died out (D. Robinson, personal comm., 2010). This species has been introduced and established in many tropical areas (Herbert and Kilburn, 2004).

Sarasinula plebeia
This pest is unknown in the United States (D. Robinson, personal comm., 2010).

Veronicella cubensis
This pest may have originated in Cuba. Interceptions have occurred in New Orleans and southern Florida. It was found in one California county, Santa Barbara (2006) (McDonnell et al., 2008; McDonnell et al., 2009).

Veronicella sloanei
This species is thought to have been introduced to southern Florida; however, this is only based on photographic evidence (D. Robinson, personal comm., 2010).

Survey

CAPS-Approved Method*:

Visual. Survey methods for Veronicellidae spp. are the same as temperate terrestrial gastropods (USDA-APHIS, 2010a; 2010b).

Literature-Based Methods:

The main method for surveying for Veronicellidae is through visual inspections. Trapping may be used, but it should only be used to enhance visual inspections as traps are not species specific and will attract a large number of non-target species. Trap types include platform traps in which a platform is used as an artificial refuge; baited traps which use attractants like bran, beer, sugar water and yeast mixture, or other preferred food sources; or trap crop stations which use preferred crop foods (USDA-APHIS, 2010a). Molluscicides can also be used in traps; they usually come combined with a bait which serves as an attractant to the poison (Clark, 2001).

Identification

CAPS-Approved Method*:

Morphological and Molecular: Differentiation from the native species is only by dissection and only if the specimen is mature enough. All veronicellid samples should be sent to Dr. Robinson for morphological identification. All specimens will then be confirmed through molecular diagnostics performed at the CPHST Mission lab.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Easily Confused Pests

These species can be confused with one native species, *Leidyula floridana.* It may also be confused with exotic species that are either not known to be established or of limited distribution in the United States.

S. plebeia cannot be separated from *Leidyula moreleti* through external examination (Naranjo-Garcia et al., 2007).

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This datasheet was developed by USDA-APHIS-PPQ-CPHST staff. Cite this document as:

Molet, T. 2011. CPHST Pest Datasheet for *Veronicellidae* spp. USDA-APHIS-PPQ-CPHST.