

# First Report of *Nipaecoccus viridis* (Hemiptera: Pseudococcidae) Associated with Citrus Production in the United States

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## Abstract

*Nipaecoccus viridis* (Newstead), is an invasive, polyphagous mealybug pest recently found causing damage in citrus production fields in several counties in Florida, United States. In this short communication, we document the finding of this pest, its associated damage in citrus groves, and provide basic diagnostic and scouting information. *Nipaecoccus viridis* is a pest of concern, necessitating the quick development of management tools.

**Key words:** invasive species, crop pest, citrus, mealybug

*Nipaecoccus viridis* (Newstead), is an invasive mealybug from Asia (Evans and Dooley 2013) first documented in Florida in 2009 (Stocks and Hodges 2010) feeding on dodder (*Cuscuta exaltata* Engelm) in a southern Florida natural area. By 2018, there were 88 records of this species from over 40 host plant species in four counties in Florida (Broward, Martin, Miami Dade, Palm Beach) (FDACS-DPI database). Its occurrence in commercial citrus was misidentified in the field as cottony cushion scale, *Icerya purchasi* Maskell, in November 2018 by a crop consultant (L.M.D. and M.Z.A., personal communication). However, the first author, L.M.D., noticed the difference in appearance between specimens in the infested field and cottony cushion scale the following spring when called to inspect damage and submitted samples to the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, in Gainesville, FL for identification. It was correctly identified by the second author, M.Z.A., after mounting on microscope slides in May 2019, which confirmed its presence for the first time in commercial citrus in Highlands County, Florida, United States associated with heavy damage (Ahmed et al. 2019). As of November 2019, infestations in citrus groves have been confirmed in seven additional counties: Hardee, DeSoto, Hendry, Lee, Brevard, Polk, and Indian River (FDACS-DPI database). Infestations have been documented both in mature groves with damage to fruit (Fig. 1A–D), and in young replanted trees (Fig. 2A–C). Feeding damage includes distorted fruit and leaves, branch dieback, and even tree death in young, recently planted trees (L.M.D., personal observation) (Figs. 1 and 2).

*Nipaecoccus viridis* is a polyphagous pest with a known host range that includes at least 140 plant genera in 53 families (García

et al. 2016). Several commercially grown food and ornamental species in Florida are hosts, including asparagus, avocado, chrysanthemums, citrus, grape, hibiscus, papaya, and roses (García et al. 2016, CABI 2017, EPPO Global Database 2019).

Populations of *N. viridis* have been documented from several countries in Asia, Africa, Australia, South America, the Caribbean, the Pacific Islands, and North America (CABI 2017). *Nipaecoccus viridis* is on the DROPSA list in Europe as a pest of concern to be monitored for in citrus and grape products (EPPO Global Database 2019).

This mealybug is an agricultural pest that attacks multiple agricultural crops and ornamental plants. In citrus-growing areas of Jordan, it caused such extensive damage that orchards were burned in efforts to eradicate it (Stocks 2013). Premature fruit drop has been documented to cause up to 50% of crop loss in citrus orchards (Cilliers and Bedford 1978). At low populations or as individuals, this pest easily can be missed during plant inspections as individuals tend to feed in cryptic locations, including under the sepals on citrus fruits (Fig. 3).

Cryptic feeding behavior, coupled with an ideal climate, has enabled the pest to establish damaging populations in citrus groves in Florida. In laboratory studies, *N. viridis* females can develop from egg to reproductive adult on citrus trees in approximately 19 d and the male can develop in 15 d at 32.5°C and 72.1% RH (Sharaf and Meyerdirk 1987). Reproductive biology in an open-field setting under central Florida production conditions has not yet been documented. Bagging citrus fruits had led to the higher infestations of *N. viridis* in India (Shevale 1994). The recent practice of using bags to cover the young citrus trees may have contributed to the recent *N. viridis* outbreaks. Bags are used to protect young trees against



**Fig. 1.** (A–D) *Nipaecoccus viridis* damage to fruit showing white wax, sooty mold and fruit distortion in mature grove (photo credits A, C, D: L. M. Diepenbrock, B: T. Weeks).

citrus greening disease by keeping out its vector, Asian citrus psyllid, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae). Managing *N. viridis* with exclusion bagging is one of the future challenges in Florida citrus production.

### Tentative Field Diagnostics

*Nipaecoccus viridis* is one of several mealybug species found feeding on citrus in Florida. However, it is the only one documented in Florida to cause fruit distortion (Fig. 1A and C). Another mealybug, *Maconellicoccus hirsutus* (Green), pink hibiscus mealybug, can also cause fruit distortion (Williams 1996). However, it is not commonly found on citrus. Unlike other species found in Florida citrus, *N. viridis* has a dark body, exuding dark purple hemolymph when crushed, and turning black when submerged in 70% alcohol (Fig. 4). Other species found in Florida citrus have yellow or green hemolymph.

### Scouting

*Nipaecoccus viridis* expels high quantities of honeydew, leading to dense sooty mold development. While other hemipteran species in

citrus also have the capacity to produce large amounts of honeydew, the high reproductive rate (Sharaf and Meyerdirk 1987) of *N. viridis* leads to the rapid development of large populations and associated sooty mold. Scanning trees for areas of dense sooty mold can help in scouting for *N. viridis*.

A unique aspect of Florida citrus production is the recent introduction of exclusion bags on newly planted trees to prevent access by Asian citrus psyllid (*D. citri*, the vector of the pathogen associated with citrus greening disease). These bags also provide protected habitats for pests that gain entry, which *N. viridis* has been able to do (Shevale 1994). The honeydew produced by mealybugs lands on the bags, which turn from white to black from sooty mold development (Fig. 5).

### Management Options

As a recently established significant pest of citrus, management of this pest is important to citrus growers. Currently, research is ongoing to describe the biology of this pest in Florida citrus groves, determine how widespread it is in the state, determine chemical management tools, and explore the potential of nonchemical management options

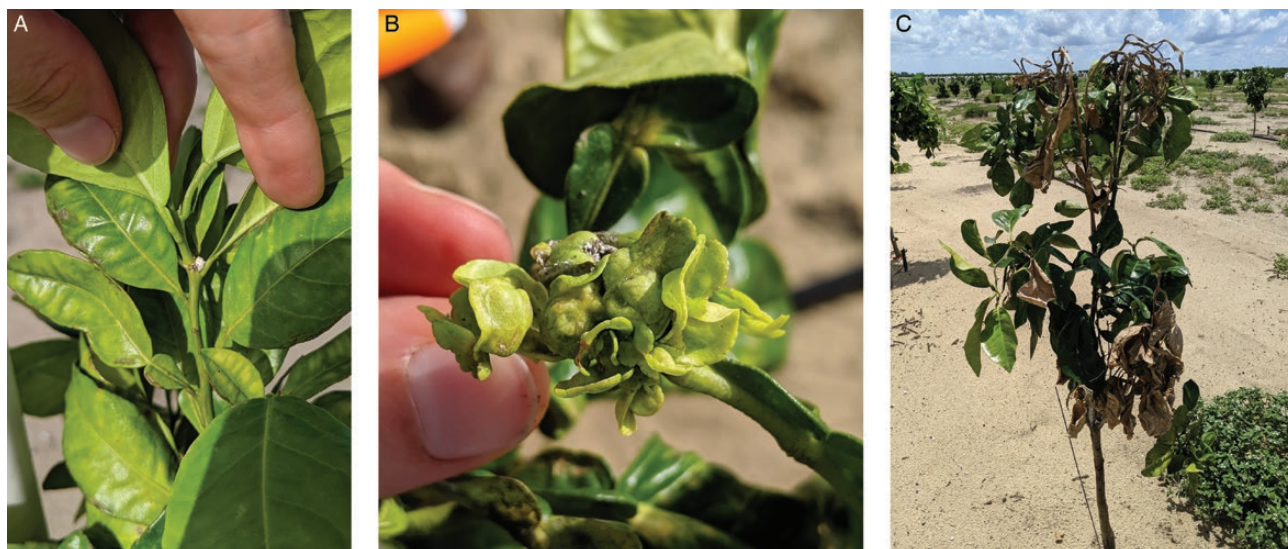


Fig. 2. (A) Individual ovisac on an immature replanted tree; (B) stunted leaf growth on immature tree; and (C) branch dieback from areas of heavy feeding (photo credits: L. M. Diepenbrock).



Fig. 3. *Nipaecoccus viridis* crawlers under the sepal on maturing citrus fruit. Part of sepal removed to show crawlers (photo credit: L. M. Diepenbrock).



Fig. 4. Materials from January 2020 Polk County, FL grower meeting. Vials contain *N. viridis* in 70% ethanol (left), several mealybugs were crushed on a paper plate to show the purple color characteristic of the hemolymph of this mealybug (photo credit: L. M. Diepenbrock).



Fig. 5. Sooty mold development on exclusion bags (photo credit: L. M. Diepenbrock).

in Florida. More broadly, it is important to understand how the use of individual protective bags for newly planted citrus has changed the citrus pest complex. New pest management tools are needed for this new agronomic environment.

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