Management of the Bagrada Bug in Nurseries

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Damage caused by the Bagrada bug, also called painted bug (*Bagrada hilaris*), has resulted in devastating crop losses for California growers. This plant-feeding stink bug infests wild mustard weeds, which are pervasive in California on hillsides and in agricultural corridors in late winter to early spring. Pest populations rapidly increase in the weeds when seasonal temperatures rise. Record numbers of bugs have invaded newly planted cole crops after the mustard weeds dry out in late summer, with the heaviest pest damage in organic vegetables. The Bagrada bug has also become a major problem in nurseries where bedding plants, plugs, and transplants are produced — attacking young vegetable and ornamental plants in the mustard family Brassicaceae (Cruciferae).

The Bagrada bug is an invasive pest species native to Africa that has spread to India, Pakistan, parts of Southeast Asia, and Italy. In the United States, it was first found in Los Angeles County in 2008. By 2011, the pest had disseminated throughout Southern California to San Diego, Imperial, Orange, Riverside, San Bernardino and Ventura counties. In September 2012, the pest moved northward to Santa Barbara and San Luis Obispo counties. Other states where this pest is currently found are Arizona, New Mexico, Nevada, Utah and possibly Texas.

The Bagrada bug is regulated as an organism of known economic importance in state quarantine programs. It currently has a B rating by CDFA, which means that the pest is subject to eradication, containment, control, or other holding action at the discretion of the individual county agricultural commissioner; when found in the nursery it is subject to state-endorsed holding action and eradication. Strict monitoring of outbound plants is required to prevent pest spread through the movement of plant material. Since the Bagrada bug can be found incidentally on a broad range of plant species, extensive crop monitoring for this pest in nurseries is necessary.

Management of the Bagrada bug requires an integrated approach of various strategies including monitoring, cultural control, mechanical control and chemical control. The information below is intended to help nursery growers in Southern California and the Central Coast manage this invasive pest and control its movement on plant material.

Pest Description

Adults are black with orange and white markings; the shield-shaped body is about ¼-inch (5-7 mm) long and about half as wide at the broadest part (fig. 1). Eggs are barrel shaped and initially white but eventually turn orange (fig. 2). Females lay eggs in the soil beneath host plants, but may also oviposit on leaves or on hairy stems of non-host plants. In addition, eggs are often laid on plant protective coverings such as mesh screens. Depending on temperature, a female bug can lay up to 150 eggs within two to three weeks that can hatch in four days. The nymph passes through five instars (fig. 3). Newly emerged nymphs of all stages are orange-red but legs, head and thorax darken quickly. Older nymphs develop wingpads prior to becoming adults.

Fig. 1. Adult Bagrada bugs are black with orange and white markings and are commonly found mating, positioned end-to-end. Note that the female (left) is longer than the male (right). Photo by John Palumbo, University of Arizona, courtesy of UC IPM.

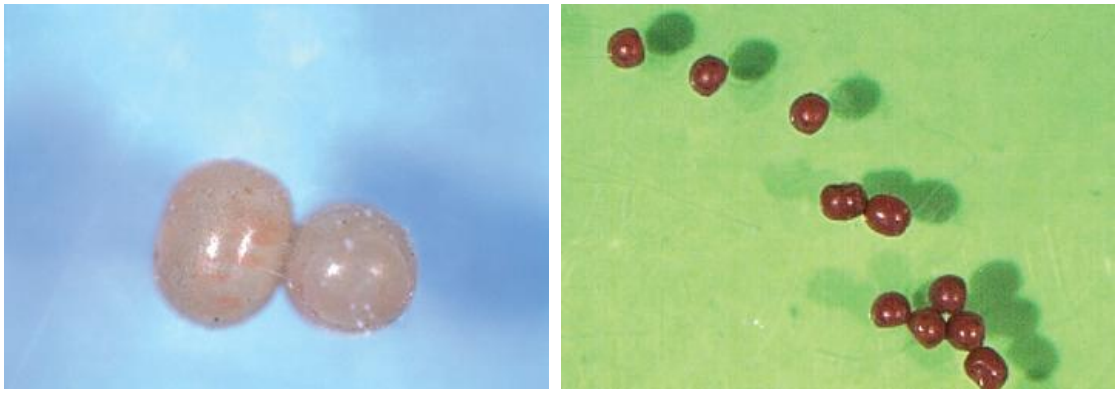

Fig. 2. Unlike other stink bugs, eggs of the Bagrada bug are laid individually or in small clusters. Newly deposited eggs are creamy white (left); whereas, those about to hatch are orange-red (right). Photo credit: T. Perring lab, UC Riverside, courtesy of USDA-NIFA Regional IPM Centers.

Fig. 3. Early instar nymphs of Bagrada bug on dried alyssum (left). Note in the close up photo (right) that the nymph resembles an adult ladybird beetle, with similar bright coloration. Photo credits: T. Perring lab, UC Riverside, courtesy of UC IPM (left); Mike Lewis, courtesy of the Center for Invasive Species Research, UC Riverside (right).

Biology

The generation cycle and number of generations per year is dependent upon the climatic conditions. In Southern California there are multiple generations each year and populations generally peak late in summer and fall. Usually all life stages are present together on plants, especially when pest densities increase, generations overlap, and food sources decrease. Even though Bagrada bugs prefer cool-season cole crops, development is favored by warmer temperatures; adults tend to fly when temperatures are above 85^{o}F. However, the insects spend more time in the soil in hot weather, where they hide, seek moisture and shade, or lay eggs. The Bagrada bugs overwinter as adults when temperatures are unfavorable; overwintering efficiency in Santa Barbara and San Luis Obispo counties is unknown at this time.

Host Range

Plants in the mustard family (crucifers) are the main hosts of the Bagrada bug. This includes cruciferous weeds such as various wild mustards, shepherd's purse, London rocket and pepperweed. Globally, the Bagrada bug is a serious pest of cole crops — cultivated plants in the *Brassica* genus such as cabbage, cauliflower, broccoli, kale, turnip and mustard greens. It also attacks related cruciferous crops such as radish and arugula. In nurseries, mustard family plants such as alyssum, stock, candytuft, rockcress and wallflower can be infested.

Bagrada bugs will also attack species in other plant families. For example, it infests weeds such as lambsquarters, purple nutsedge, *Euphorbia* spp, perennial sowthistle and field bindweed. It causes feeding damage on crops such as corn, Sudan grass, sorghum, sunflowers, papaya, potato, cotton, capers and some legumes. The Bagrada bug aggregates on many different types of plants in the fall when pest populations are high and food is scarce (fig. 4). When preferred hosts are unavailable, the bug can be found on plants that are not reproductive hosts, and it may or may not attempt to feed. For example, large numbers of Bagrada bugs have been found in Ventura County on strawberry crops, but feeding damage has not been reported.

Fig. 4. Multiple life stages of the Bagrada bug aggregate on many plants, including non-hosts, in the fall when pest populations are high and food is scarce. Photo credits: J. Taylor, OC Parks.

Plant Damage

Adults and nymphs of the Bagrada bug feed on leaves, stems, flowers and seeds. They insert their needle-like mouth parts into young leaves, inject digestive enzymes and suck the juices, which results in starburst-shaped lesions (fig. 5). Leaves eventually have large stippled areas and may wilt and die. Ultimately damage results in "scorched" leaves, stunting, blind terminals, and forked or multiple heads on cauliflower, broccoli and cabbage. Bagrada bugs are particularly damaging to small plants and may kill seedlings.

Fig. 5. Typical fresh feeding damage appears light green with starburst lesions and then bleaches with age, giving leaves a "scorched" appearance when feeding is heavy (left). Multiple stages of Bagrada bug adults and nymphs (not shown) have caused large white stippled areas on alyssum (right). Photo credits: J. **Palumbo, University of Arizona, courtesy of USDA-NIFA Regional IPM Centers (left); G. Arakelian, Los Angeles County Agriculture Commissioner's Office, (right).**

Pest Management

Monitoring. Early detection is important because populations can build up quickly. Level of infestation may be correlated with proximity to natural and cultivated areas infested with wild mustards or to neighboring organic vegetable farms. All plants should be regularly inspected, especially in-coming and out-going plant shipments and all host crops/weeds. More frequent monitoring may be necessary when temperatures rise above 75^{o}F. When temperatures are low or extremely hot, these bugs may hide on the undersides of leaves, around stem bases, or in moist soil cracks and crevices. Bagrada bugs may not be readily observed until damage has begun so look carefully for fresh feeding damage (light green starburst lesions), which may be easier to spot than the insects themselves. A good time to inspect is right after irrigating when pests hiding in the space between the potting mix and the sides of the container may be flushed out and more easily detected. When the bugs are common, they may be monitored by beating or by shaking plants over a tray or a sheet of paper.

Cultural control. Remove weed hosts in and near production areas. Bagrada bug adults, eggs and nymphs in the soil or container media can be controlled by steam or chemical treatment before planting. When bugs are abundant, isolate crucifers in a separate area in the nursery. Removal of crop residue after harvest can reduce carry-over between crops.

Mechanical control. Picking the bugs off plants by hand is only feasible if pest populations are very low. When infestations are heavy, it may be possible to vacuum the bugs with a portable vacuum cleaner. Using wild hosts as trap crops should be conducted very carefully because the trap crop could also serve as a source of infestation for nursery plants. Growers that have access to greenhouses can protect cruciferous bedding plants and vegetable plugs by producing them inside. Using a double-door system in greenhouses can help to exclude the bugs, and screened vents prevent entry of flying adults. As an alternative to greenhouses, screened tunnels or floating row cover fabric can provide plant protection. The mesh of the screening material must be fine enough to exclude the Bagrada bug nymphs and should be elevated so that it does not touch the plants because the bugs can feed through these coverings. The edges of protective covers must also be buried to prevent the bugs from crawling underneath to the plants.

Biological control. The Bagrada bug is not native to California and there are no natural enemies here that specifically attack it, although spiders and other general predators may feed on it. Stink bugs are so named because they secrete a foul-smelling liquid that is repulsive to many predators. Birds apparently find the taste of these bugs unpleasant and may avoid eating them. Several parasitoids that attack eggs, nymphs and adult Bagrada bugs are reported in the literature, but thus far effective biological control organisms have not been identified despite the importance of this pest in many countries. Unlike the harlequin bug, which it strongly resembles, the Bagrada bug often lays eggs in the soil, which would render egg parasitoids such as wasps ineffective. Moreover, although biological control options are currently being evaluated by some researchers, Bagrada bug densities can increase rapidly and biological control alone will not keep populations in check.

Chemical control. There is little information on chemical control of the Bagrada bug in nurseries. Generally, stink bugs are difficult to manage with insecticides, and repeat applications are often necessary. Research on managing this pest on cole crops suggest that synthetic pyrethroids, neonicotinoids, and organophosphate compounds may be effective in minimizing the damage. However, the adult bugs usually escape injury by flying away before they are contacted only to return later. Growers that are producing nursery plants organically have no effective chemical options, although insecticidal soap and horticultural oils, including neem oil and paraffinic oil, may provide some control against the nymphs. Organic crops should therefore be grown under cover or with screening to exclude bugs. Check the pesticide label to make sure the product is registered for use on nursery crops. Rotating chemicals with different modes of action is very important to minimize potential resistance problems.

Class	**MOA Group**	**Common Name**	**Trade Name**	**Formulation**	**Registered Use-Crop**	**Registered Use-Site**	**REI hours**
neonicotinoid	4A	Imidacloprid	Marathon II	2F	ornamentals and vegetables	N, GH	12
neonicotinoid	4A	Acetamiprid	TriStar	30SG	ornamentals	N, GH	12
neonicotinoid	4A	Thiamethoxam	Flagship	25WG	ornamentals	N, GH	12
organophosphate	1B	Acephate	Acephate Pro	75WP	ornamentals	N, GH	24
pyrethroid	3	Cyfluthrin	Decathlon	20WP	ornamentals	N, GH	12
pyrethroid	3	Bifenthrin	Talstar*	NF	ornamentals	N, GH	12
pyrethroid	3	Fenpropathrin	Tame*	2.4EC	ornamentals	N, GH	24

soap	M	Potassium Salts	M-pede	40%	ornamentals and vegetables	N, GH	12
pyridine carboxamide	9B	Flonicamid	Aria	50%	ornamentals	N, GH	12
benzoyl-urea	15	Novaluron	Pedestal	10SC	ornamentals	N, GH	12
botanical	3	Pyrethrins	Pyganic	EC 1.4 II, EC 5.0 II	ornamentals and vegetables	N, GH	12
oil	M	Neem oil extract	Triact	70	ornamentals and vegetables	N, GH	4
		N=Nursery, GH=greenhouse * Restricted Use					

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