The Evolution of Bagrada Bug Management in Desert Cole Crops: The Legacy of John C. Palumbo (2010–2025)

Macey Keith, Wilfrid Calvin, *University of Arizona, Department of Entomology*

The emergence of *Bagrada hilaris* (Bagrada bug) as a serious pest in desert vegetable systems marked a defining moment for integrated pest management (IPM) in the Southwest. First reported in California in 2008 and reaching Yuma, Arizona by 2009 [1], the invasive stink bug quickly established itself as a destructive pest of cole crops. By fall 2010, widespread infestations caused severe stand losses, particularly in broccoli, cauliflower, and cabbage [2]. Early observations led by John C. Palumbo at the University of Arizona's Yuma Agricultural Center documented characteristic "star-shaped" feeding lesions (**Figure 7)** and stand reductions of up to 35% [2]. Immediate responses centered on chemical control, where pyrethroids and organophosphates proved most effective for quick knockdown. However, Palumbo recognized the need for a long-term, research-driven management framework beyond emergency spraying.

Between 2010 and 2012, early field trials and Pest Control Advisor (PCA) surveys shaped the first science-based understanding of the pest's seasonal biology and behavior. These studies established that Bagrada bug populations peaked during warm, dry periods and that the critical window for crop vulnerability extended from seedling emergence through the 4–6 leaf stage [3]. His extension updates emphasized preventive chemigation with contact insecticides during stand establishment to protect young plants.

By 2013, research had progressed beyond basic pest identification to include behavioral ecology, revealing that *Bagrada bug* adults were most active from late morning through mid-afternoon, especially when temperatures rose above 90°F [4]. **Figure 1** summarizes these diel activity patterns, illustrating that adult walking and feeding behaviors peak during warm daylight hours and nearly cease at night. This discovery reshaped field scouting practices, leading PCAs to monitor crops in mid-day rather than early morning when adults were inactive and less visible. This understanding transformed field scouting practices, advising PCAs to sample during warm daylight hours rather than early morning when adults are less visible.

Subsequent studies correlated feeding injury with adult density, revealing that a nominal action threshold of five percent of plants showing new feeding damage provided an accurate trigger for insecticide applications [5]. **Figure 2** depicts this relationship—showing that even modest increases in adult density can cause rapid increases in feeding damage. This marked the transition toward an IPM approach that balanced intervention timing with crop development.

From 2010 through 2020, a decade-long collaboration with Arizona and California PCAs tracked Bagrada bug abundance and management trends across thousands of desert acres[6]. **Figure 3** shows how average Bagrada bug pressure declined sharply from 2010 to 2019, while **Figure 4** reveals how insecticide use closely tracked pest presence—

demonstrating the economic importance of the pest and the strong motivation to protect stands during establishment. Survey data showed that infestations declined from more than 90% of cole crop acreage in 2010 to less than 40% by 2018. Over the same period, average yield losses dropped from 14% to below 3%. This dramatic improvement reflected refined insecticide use but also the adoption of better scouting protocols, seed treatments, and area-wide awareness. Laboratory assays conducted ten years apart (2010 and 2020) confirmed that Bagrada bug populations remained susceptible to major insecticide groups, with no significant resistance detected to bifenthrin, lambda-cyhalothrin, methomyl, or dinotefuran [6,7].

A major advancement during this period was the introduction of NipsIt® seed treatment (clothianidin), which provided 14–21 days of seedling protection against Bagrada bug feeding [6]. **Table 1** summarizes adoption trends and PCA performance ratings, showing that treated acreage peaked in 2016 and consistently delivered good-to-excellent control. The success of NipsIt® reduced the need for multiple foliar and chemigation sprays during stand establishment and demonstrated how seed treatments could serve as the first line of IPM defense.

Later work incorporated environmental and ecological context, emphasizing how temperature and moisture shape pest abundance. A 2024 *Veg IPM Update* demonstrated that warm-season pests such as Bagrada bug, diamondback moth, whiteflies, and thrips thrive between 75 and 100°F, whereas cool-season pests like aphids and seedcorn maggot prevail under 40–65°F[10]. **Figure 5** visualizes these temperature ranges, showing why Bagrada bug is a warm-season pest rarely observed during winter months in the desert Southwest.

The knowledge from over a decade of field data was synthesized into a comprehensive, resistance-aware management framework. **Figure 6** presents the current seasonal rotation of insecticide MoA used for Bagrada bug control. Neonicotinoid seed treatments (IRAC 4A; clothianidin/NipsIt®) provide early protection during planting and stand establishment. Pyrethroids (IRAC 3A) remain the primary knockdown tools via chemigation or foliar spray. Organophosphates (IRAC 1B) and carbamates (IRAC 1A) serve as rotational contact materials during the early vegetative period. This integrated sequence of MoA groups embodies the evolution of Bagrada bug management—from emergency control toward an adaptive, sustainable IPM system.

By 2024, this guidance had evolved into a standardized, comprehensive management framework. The updated recommendations prioritize scouting for fresh feeding injury (**Figure 7**) rather than adult counts, with treatments initiated once five percent of plants exhibit damage [9]. Pyrethroid chemigation remains the main method of control during stand establishment, supplemented by foliar applications when necessary. For transplants, scouting should begin the morning after planting, and for direct-seeded fields, a prophylactic treatment is advised at seedling emergence, particularly when planting near infested fields or grassy areas harboring weedy mustards [9].

As of 2025, the integrated approach to Bagrada bug management that Palumbo helped pioneer serves as a model for successful IPM adoption in desert vegetable production. Through the combined efforts of researchers, field collaborators, and Extension outreach, behaviors have shifted from routine, calendar-based spraying to a more adaptive, weather-informed system guided by thresholds and field observations. This evolution now balances effective pest control with long-term economic sustainability. In just over fifteen years, John C. Palumbo transformed Bagrada bug management from crisis to control. His impact lives on through the IPM practices he helped define.

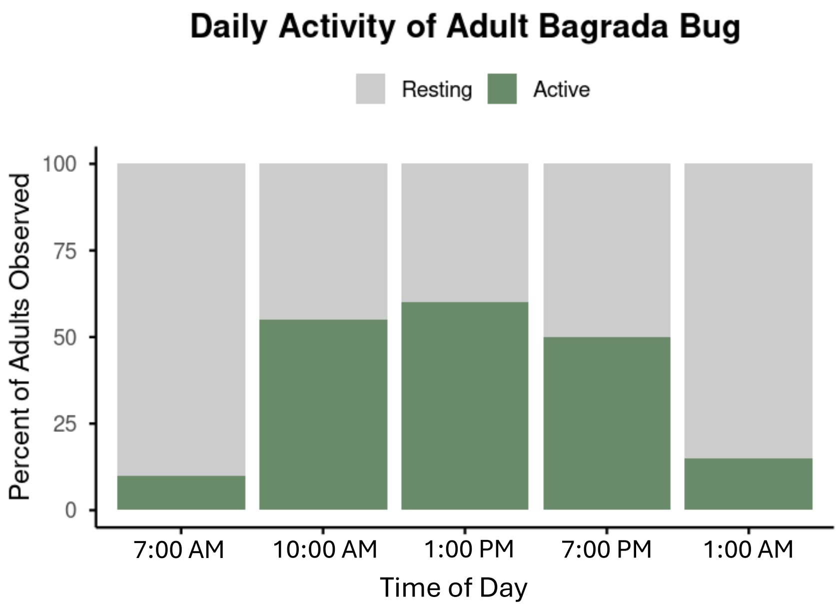

Figure 1. Simplified summary of adult Bagrada bug activity over a 24-hour period. Data were adapted from greenhouse studies by combining walking and feeding behaviors and averaging male and female observations. Five representative times of day were selected to highlight the main pattern—adults are most active during warm daylight hours and least active at night.[4]

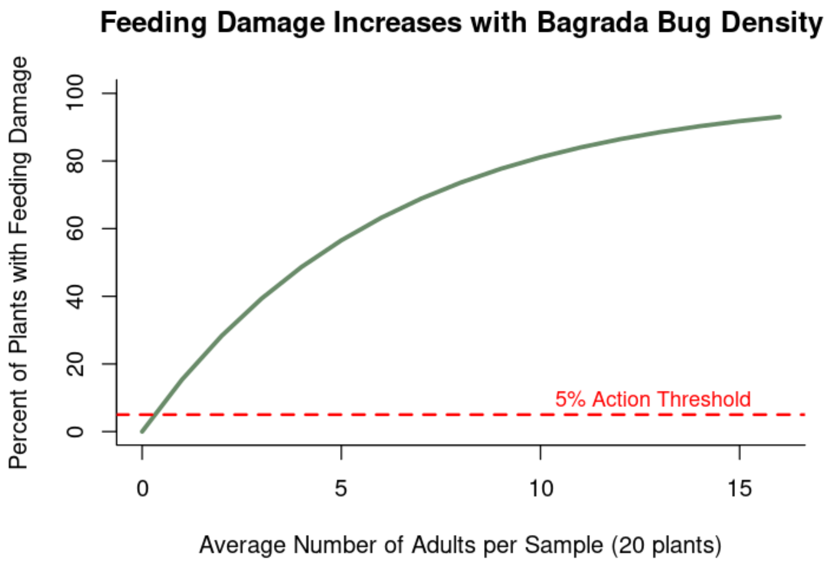

Figure 2. Feeding damage increases as Bagrada bug numbers rise. The curve summarizes findings showing that even small increases in adult bug density can lead to rapid increases in plant injury. The dashed red line marks the 5% action threshold commonly used to guide treatment decisions in desert cole crops.[5]

Year	Acres Planted with NipsIt®	% of Total Broccoli Acres	Performance Rating[1][1]
2015	2,760	41.2	4.5
2016	2,950	66.7	4.4
2017	5,750	56.1	4.1
2018	1,100	12.2	4.5
2019	1,200	20.9	4.5

[1] Performance rating based on a 1–5 scale: 1 = no control, 5 = excellent control.

Table 1. Adoption and performance of NipsIt® seed treatment (clothianidin) in broccoli from 2015 to 2019 based on PCA survey responses. Reported acreage planted with treated seed varied by year, while performance ratings remained consistently high across seasons.[6]

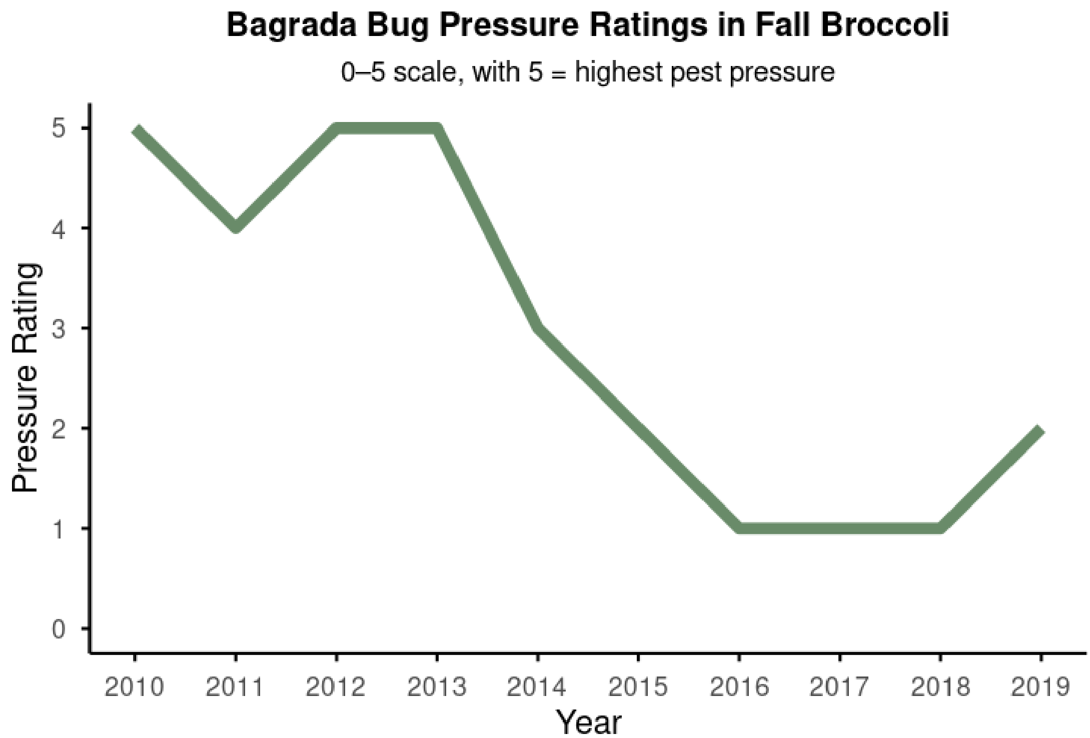

Figure 3. Annual (2010-2019) Bagrada bug pressure ratings (0–5 scale) in non-treated broccoli plots at the Yuma Agricultural Center, 2010–2019. Ratings show changes in seasonal pest pressure over time.[6]

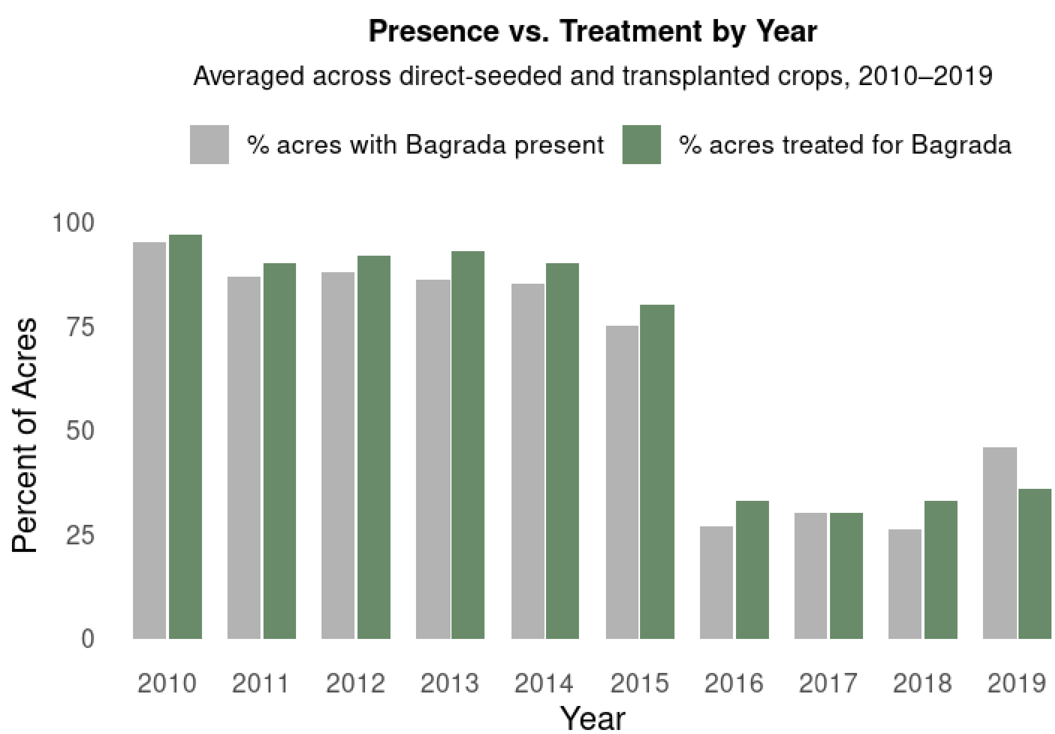

Figure 4. Percentage of surveyed broccoli acres where Bagrada bug was present and where insecticide treatments were applied, averaged across direct-seeded and transplanted crops from 2010–2019. The close overlap between pest presence and treatment emphasizes the economic importance of this pest—PCAs often treated proactively to protect stands during establishment, reflecting its historically high risk to yield and plant survival.[6]

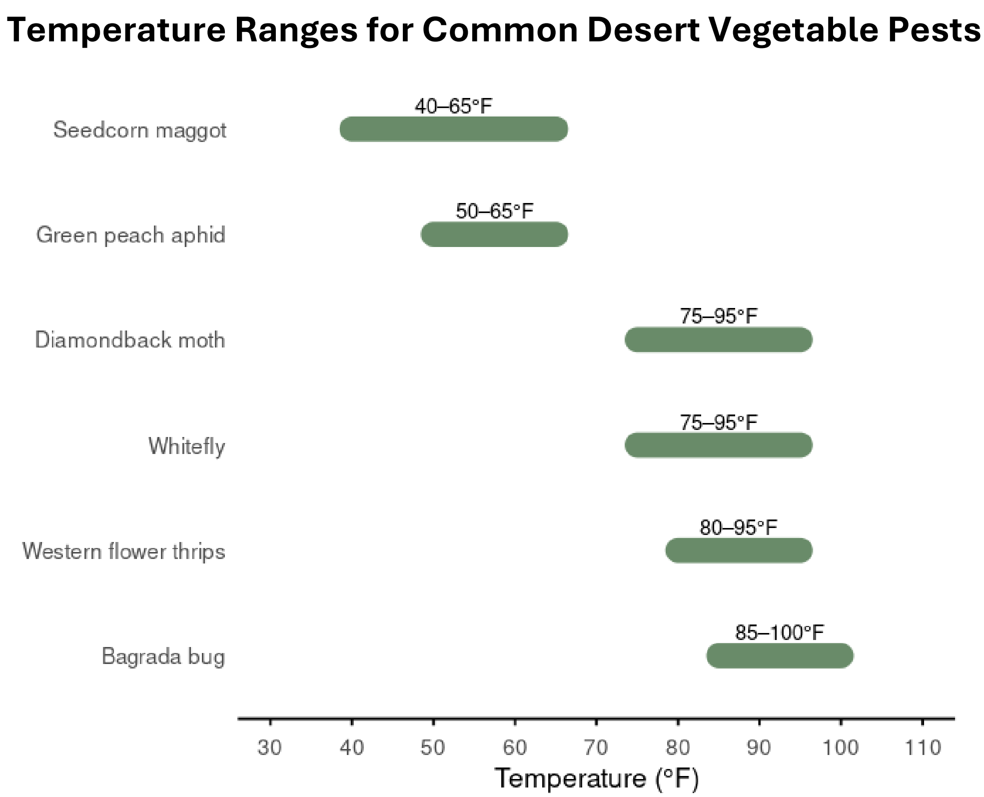

Figure 5. Approximate temperature ranges associated with optimal development and activity of common insect pests in desert vegetable crops. Cool-season pests such as seedcorn maggot and green peach aphid are most active under moderate temperatures (40–65°F), whereas warm-season pests including diamondback moth, whitefly, western flower thrips, and Bagrada bug exhibit peak activity at higher temperatures (75–100°F).[10]

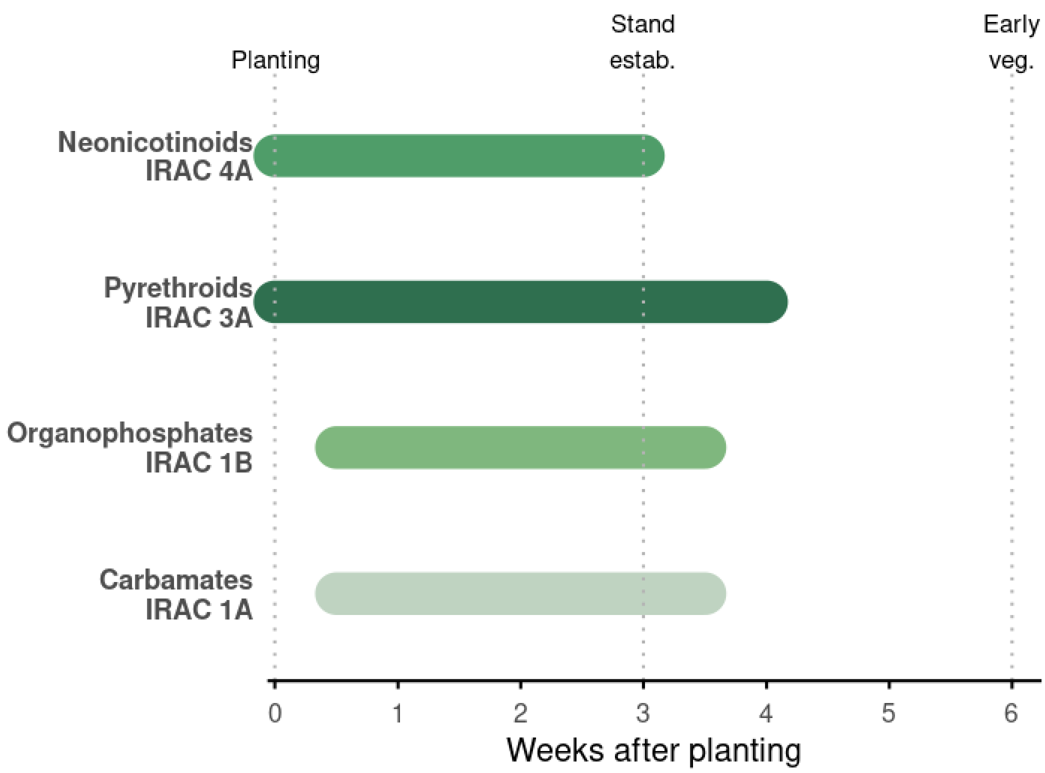

Figure 6. Timing of insecticide use and IRAC MoA groups for Bagrada bug management in desert cole crops. The x-axis shows crop stages from Planting to Stand establishment (Stand estab.) and Early vegetative growth (Early veg.). Neonicotinoid seed treatments (IRAC 4A; clothianidin/NipsIt®) protect seedlings through establishment, while pyrethroids (IRAC 3A) provide foliar or chemigation knockdown during this period. Organophosphates (IRAC 1B) and carbamates (IRAC 1A) are rotational contact options used mainly in early vegetative growth.[8,6]

Figure 7. Top left: Fresh feeding lesions on 2-leaf stage broccoli. Bottom left: Old feeding lesions on 2-leaf stage broccoli. Top right: Fresh feeding on cotyledons. Bottom right: Old feeding on cotyledons.[5]

References

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