COLLEGE OF AGRICULTURE & LIFE SCIENCES
Arizona
Experiment Station
Yuma Agricultural Center

Impact of Bagrada Bug Infestations on Desert Cole Crops, 2010-2015

John C. Palumbo, Yuma Agricultural Center

The Bagrada bug, *Bagrada hilaris,* became a major pest of cole crops in the fall on 2010. Widespread infestations of this invasive stinkbug pest were reported throughout the desert growing areas in September and October of that year where stand losses and yield/quality reductions to broccoli, cauliflower, cabbage and other *Brassica* crops were considered economically significant. In an attempt to document these impacts, we have surveyed produce growers and PCAs from Yuma Co., Imperial Co., and Maricopa Co. on an annual basis since 2010 to estimate the severity of Bagrada bug infestations on direct-seeded and transplanted cole crops, and the intensity of chemical management.

PCAs and growers were anonymously asked to estimate the fall acreage (August-November) they managed, and of those acres the percentage where *Bagrada* populations were present, what percentage required insecticide treatments and how often. In addition, they were asked to estimate, on average, percent stand losses and plant injury caused by *Bagrada* infestations. Finally, PCAs and growers were asked to list the insecticide products they found to be effective in controlling Bagrada adults when applied as either sprinkler chemigations or foliar sprays. Information was collected separately for direct-seeded (e.g. broccoli) and transplanted (e.g., cabbage, cauliflower) cole crops. In 2015, we asked for information specific to organic cole crops production. Table 1 shows the number of PCAs who participated in the surveys each year and the acres their estimates represented.

Table 1. Number of PCA/grower respondents who participated in the Bagrada survey and the acreage that their estimates were based on.

Season	No. PCAs responding	Cole Crop Acres Estimated in Survey		
		Direct-seeded	Transplanted	Total
2010	17	9310	4610	13920
2011	13	6210	3450	9660
2012	19	6290	4595	10885
2013	21	7255	5435	12690
2014	19	6080	8080	14160
2015	20	6700	6400	13100

Impact of Bagrada Bug Based on Insecticidal Control

Since the initial Bagrada bug outbreaks in 2010 it is clear that this invasive stink bug has become an important, established pest on desert cole crops. Based on seasonal population abundance studies of adults infesting non-treated broccoli plants at the Yuma Ag Center (Fig 1), bagrada bug infestations in 2015-16 were the lowest we've experienced since the pest first appeared in the desert. Results from the PCA surveys also indicated that Bagrada populations were lighter in 2015. Based on PCA estimates over the past 6 seasons,

bagrada bug infestations have been present on greater than 90% and 85% of the direct seeded and transplanted cole crop acreage, respectively (Table 2). In direct seeded crops, the percentage of acreage treated for Bagrada adults was about equal with the number of infested acres. This is not surprising given the importance of controlling Bagrada infestations at stand establishment in order to reduce stand losses and plant injury. This is likely reflected as well by the large number of acres chemigated (~80%) on an average of 1.5 times since the initial outbreaks. However, once sprinkler pipe was removed from the field, the survey reports that management for Bagrada remained intensive where about >80% of the reported acres were sprayed an average of 2.2 times in direct seeded-crops and over 76% of transplanted crops were sprayed almost 2 times. Overall, a lower percentage of transplanted cole crops required treatments. When the number of chemigations and foliar sprays are combined over all six years, on average 3.7 insecticide applications were made to control this pest on direct-seeded crops and 3.1 applications on transplants. In 2015, growers of direct-seeded crops chemigated and treated fewer times for Bagrada than in all other years.

Impact of Bagrada Bug Based on Crop Losses

Estimates of stand losses from bagrada bug infestations at stand establishment in both direct-seeded and transplanted crops has decreased by more than 50% over the past 5 years (Table 3). Stand losses in 2015 were quite low relative to the previous year. Feeding injury, defined as plants with multiple heads, forked terminals, and/or blind terminals resulting from Bagrada feeding, was also lower in 2015. Plant injury in direct seeded crops was lower than in 2015 than in any other season. In transplanted crops, estimates of injury were lower than other years. The percent plant damage has typically been lower in transplanted crops and suggests that newly, hardened transplants may withstand feeding injury better during stand establishment, and further suggest that injury occurring in cole crops is most important on very young seedlings (i.e., cotyledon-2 leaf plants). These reported losses are consistent with stand losses and plant injury measured in trials conducted at the Yuma Ag Center over the past four years.

Organic Production

This year we collected data specifically for organic cole crops production. Two PCAs reported estimates from 750 ac of transplanted cole crops (cabbage, cauliflower and broccoli). It was reported that Bagrada was present on 100% of the acers, where 70% were treated via chmigation and 52% were treated via foliar sprays. It was estimated that the 3% of the organic crops reported on suffered stand losses and 10% of the crop suffered from plant injury. Pyganic was the only product listed for chemigation and a combination of Entrust +M-Pede was used for foliar sprays.

Effective Insecticides:

Over the past 6 years, growers and PCAs reported using pyrethroids almost exclusively to control Bagrada bugs during stand establishment via chemigation through sprinklers (Figure 2). Among the insecticide active ingredients (AI) reported as effective, bifenthrin (Brigade, Sniper, Hero and Discipline) was the most commonly reported, followed by lambda-cyhalothrin (Warrior II, Lambda-Cy) and zeta-cypermethrin (Mustang, Hero). Several other pyrethroids were reported as being effective including esfenvalurate (Asana) and permethrin, but were used by relatively fewer PCAs. One PCA reported using imidacloprid (Alias) in 2010, but since then no use of this AI has been reported. In 2013 and 2014, PCAs reported using Endigo, an in-can mixture of thiamethoxam and lambda-cyhalothrin, but none was reported in 2015. In general, comments provided on the survey suggested that pyrethroid chemigations appeared to provide effective knockdown control of adults, but under heavy Bagrada bug pressure re-application was often necessary after 2-3 days.

In contrast, a broader array of AIs was reported for use against *Bagrada* when applied as foliar sprays on established stands. However, pyrethroids remain the most commonly reported chemistry used. Bifenthrin was the most commonly used AI, followed by lambda cyhalothin, zeta-cypermethrin, and esfenvaluate. Among the alternative chemistries used, dinotefuran, methomyl and chlorpyrifos were reported to be effective against Bagrada adults by several PCAs, and a number of neonicotinoids, and pyrethroids were reported less frequently. Reports of neonicotinoid usage for Bagrada control decreased in 2015. These estimates are consistent with results from efficacy trials conducted at Yuma Ag Center where products that have contact activity (i.e.,

Pyrethroids, OP/Carbamates) have provided the most effective control against Bagrada adults on both direct-seeded and transplanted cole crops.

Nipsit Treated Seed

We also asked PCAs and growers for the first time in 2015 about their experiences with the newly registered insecticide seed treatment for broccoli, NipsIt (containing clothianidin). A total of 8 PCAs reported their growers used the product on an estimated 1400 acres. Most of the responses were very positive and felt that the product performed very well for controlling bagrada bugs at stand establishment. One PCA reported that the product provided 20 days of control, and several PCAs reported that using the product resulted in fewer sprays needed for Bagrada control.

Acknowledgement

Special thanks go out to all the PCAs and growers who took time away from their busy schedules to participate in these surveys over the past five years. Without you, this data would not exist.

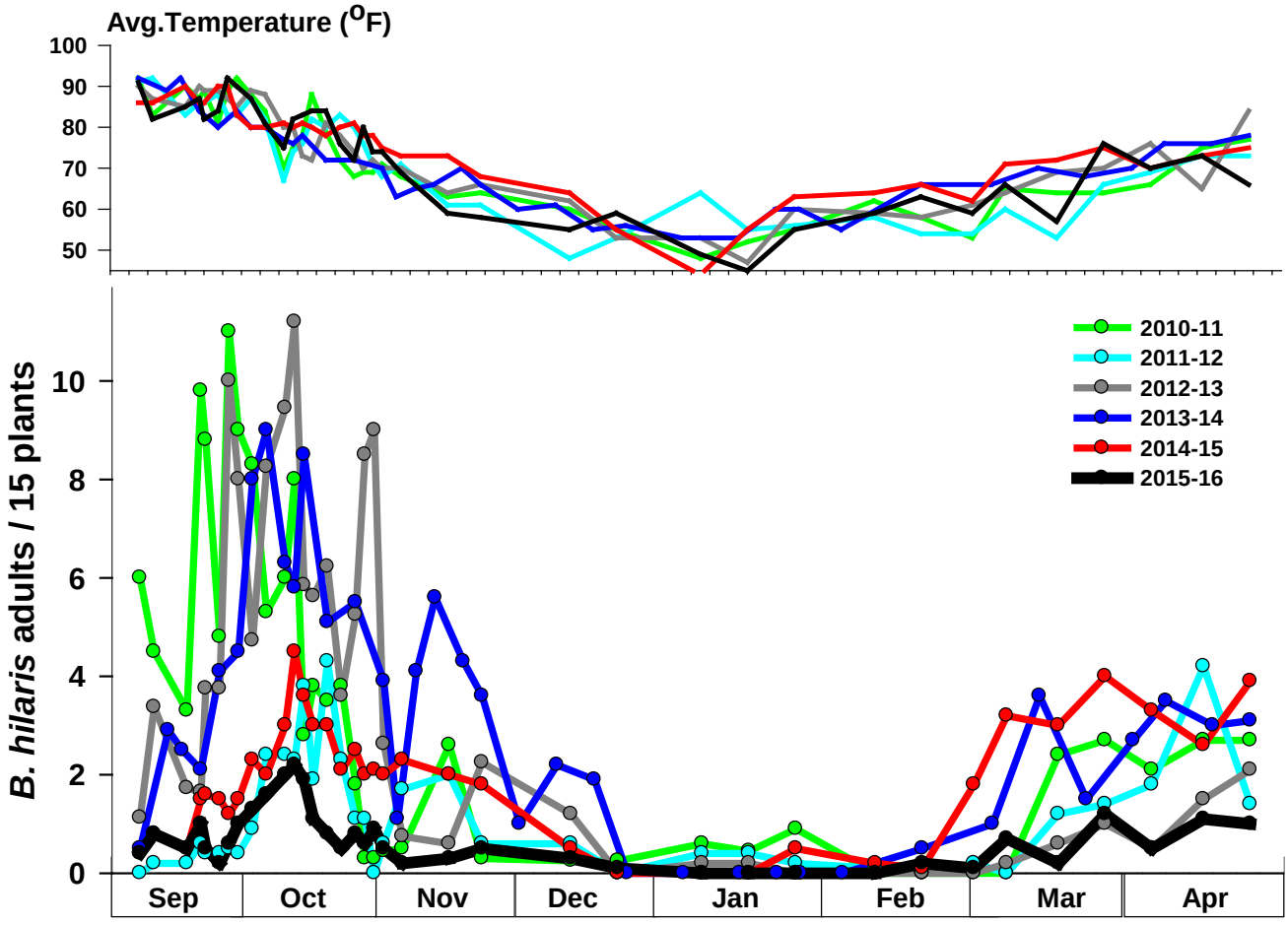

Figure 1. Bagrada bug abundance (adults/15 plants) in non-treated broccoli plots relative to ambient air temperatures at the Yuma Agricultural Center from September 2010 through April 2016.

Table 2. Impact of Bagrada bug on desert cole crops based on chemical control.

	Direct-seeded							Transplanted						
Chemical Control for *Bagrada*	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***Avg.***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***Avg.***
% acres where *Bagrada* present	95.8	87.6	87.2	89.1	95.0	90.3	***90.8***	94.4	87.0	86.7	73.2	82.8	88.9	***85.5***
% acres treated with insecticide	95.8	91.3	87.4	92.4	85.3	87.2	***89.9***	88.3	84.3	84.4	74.1	78.8	92.6	***83.8***
% acres chemigated	73.8	75.2	85.5	87.1	75.6	85.9	***80.5***	60.6	72.0	65.1	67.4	64.8	79.3	***68.2***
Avg. no. of chemigations applied	1.6	1.6	1.6	1.5	1.6	1.3	***1.5***	1.4	1.3	1.1	1.3	1.4	1.3	***1.3***
% acres sprayed with insecticide	90.0	87.0	86.8	88.5	76.3	60.1	***81.5***	85.6	80.8	82.8	67.9	70.8	71.4	***76.6***
Avg. no. of sprays applied	2.7	1.8	2.5	2.5	2.2	1.4	***2.2***	2.1	1.8	1.8	1.9	1.5	1.8	***1.8***
Total avg. no. applications	4.3	3.4	4.1	4.0	3.8	2.7	***3.7***	3.5	3.1	2.9	3.2	2.9	3.1	***3.1***

Table 2. Impact of Bagrada bug on desert cole crops based on chemical control.

	Direct-seeded							Transplanted						
Impact of Bagarada on Crops	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***Avg.***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***Avg.***
Avg. % stand loss	6.3	2.5	2.8	3.9	3.2	2.6	**3.6**	3.1	1.5	1.4	1.7	1.6	1.6	**1.8**
Avg. % plant injury	8.0	4.2	3.2	7.9	5.5	2.9	**5.3**	4.6	3.9	2.1	5.8	3.1	3.6	**3.9**
Avg. total % crop Loss	14.3	6.7	6.0	11.8	8.7	5.5	**8.8**	7.7	5.4	3.5	7.5	4.7	5.2	**5.7**

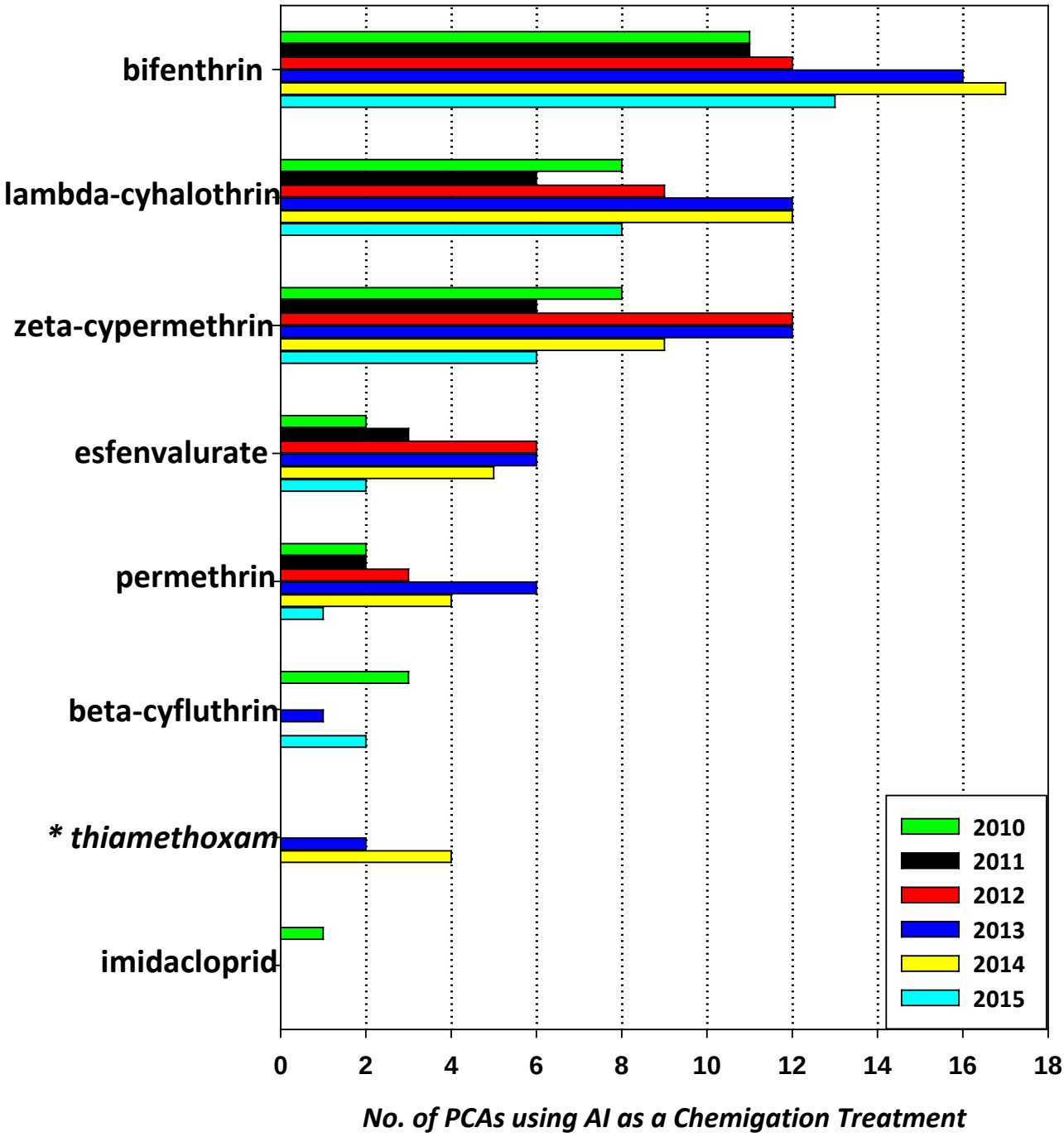

Figure 2. Insecticide AIs reported as effective against bagrada adult infestations when applied as chemigation treatments during stand establishment on cole crop fields in Yuma Co., Imperial Co. and Maricopa Co. in 2010-2015. * represents Endigo, a mixture of lambda cyhalothrin and thiamethoxam.

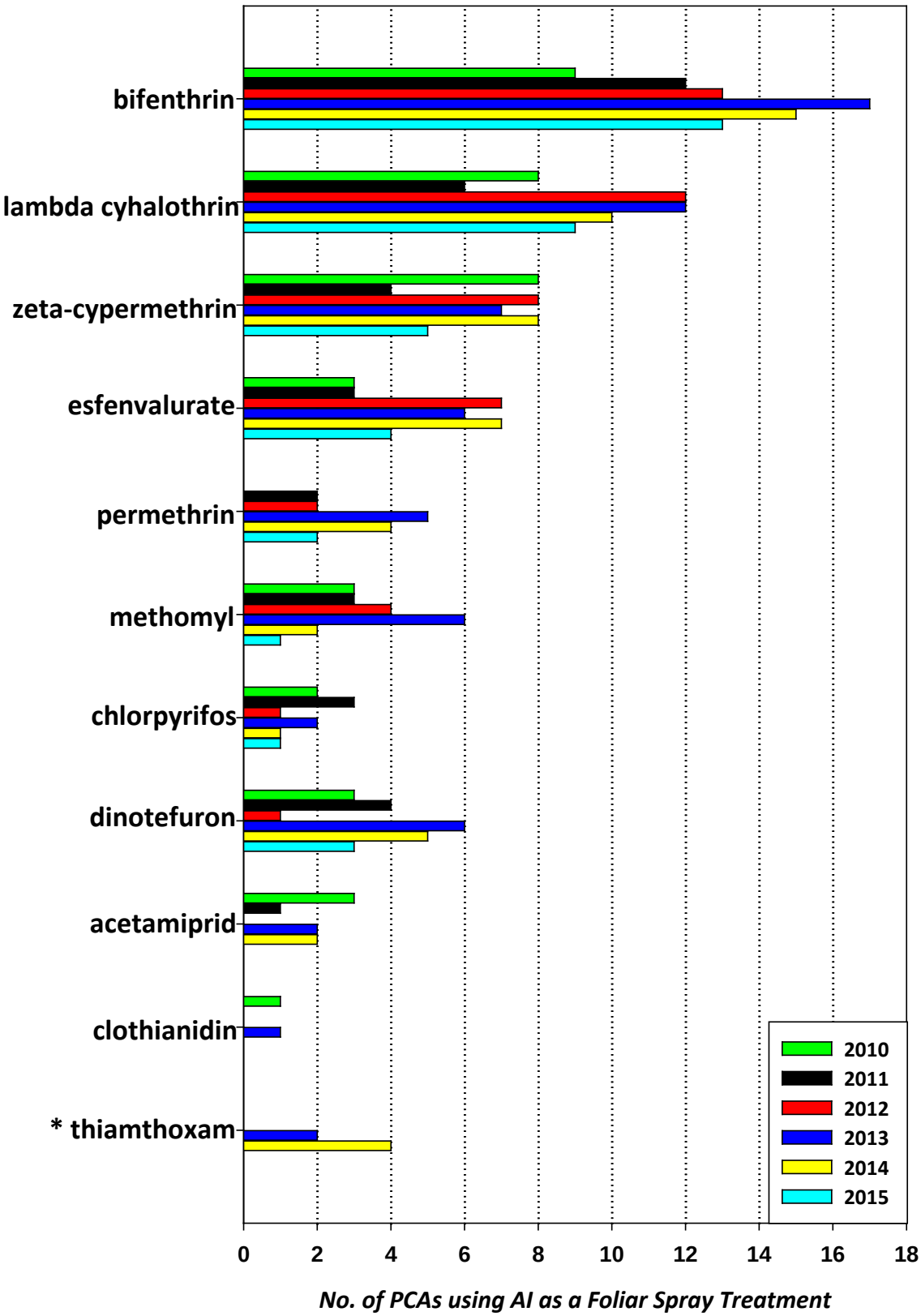

Figure 3. Insecticide AI s reported as effective against bagrada bug adult infestations when applied as foliar spray treatments on established cole crop fields in Yuma Co, Imperial Co. and Maricopa Co. in 2010-2015.
* represents Endigo, a mixture of lambda cyhalothrin and thiamethoxam.