

Abstract

Bed bugs resurged as an important public health pest in recent years in the U.S., Canada, Europe, and Australia. They pose serious financial burden to communities and affect people's quality of life. A survey of 17 affordable housing communities in New Jersey showed up to 40% of the housing units were reported being infested with bed bugs. Major factors contributing to the increasing bed bug infestations include, lack of early detection, failure of resident cooperation, and ineffective control practices. We designed and evaluated an innovative bed bug lure, a bed bug trap, and a community-wide bed bug integrated pest management (IPM) program. The experimental bed bug lure improved the efficacy of bed bug monitors by 2.2 times. A new pitfall trap design was significantly more effective than the most effective monitor available in the market for bed bugs. A sugar-yeast mixture formula was developed as an inexpensive, safe, and convenient carbon dioxide source for attracting bed bugs. Proactive bed bug inspections in four low income communities in New Jersey revealed an average of 13.1% bed bug infestation rate. A community-wide bed bug management program resulted in 98% reduction in bed bug counts and reduced infestation rate by 82% after 12 months.

Background

Since the 1990s, bed bugs have re-emerged as an important urban pest (Potter 2006) (Figs. 1-4). In 2011, bed bug related products and services rose to the 2nd largest revenue group in the pest control industry in U.S. Nationwide. Among those affected, low-income housing communities experience disproportionately higher bed bug infestation rates than the rest of the society. A survey of 16 housing authorities in New Jersey during November 2012 revealed up to 40% of the units were infested with bed bugs. Unlike other common household pests, bed bug bites cause itchiness, pain, anxiety, loss of sleep, social ostracism, delusional parasitosis, and stress. The lack of effective monitoring and control methods, insecticide resistance, and increased travel are some of the factors that contributed to the bed bug resurgence. To help combat the current bed bug resurgence problem, we designed a series of studies in order to develop more practical and effective bed bug management solutions.



Fig. 1. Bed bug egg, nymphs and a male adult.



Fig. 2. Bed bug bite symptom.

Objectives

1. Investigate the current bed bug infestation patterns in selected low income communities;
2. Develop an effective bed bug lure;
3. Develop a cost effective bed bug monitoring device;
4. Design and implement a community-wide bed bug management program.



Fig. 3. Bed bugs on a box spring.



Fig. 4. Heavy bed bug infestation on a bed.



Fig. 5. Climbug™ insect interceptor placed under a bed leg for detecting bed bugs.



Fig. 6. Visual inspection of bed bugs.

Results

Community-wide inspections using a combination of visual inspections, interviews, and placing Climbug interceptors under furniture legs were conducted in 4 low income housing communities in New Jersey during February-April 2014 (Figs. 5, 6). The inspections revealed that bed bug infestation rates in low income communities were high. The average infestation rate was 13.1% (Wang, C., unpublished data) (Table 1).

Table 1. Bed bug infestations in four low income communities in 2014.

City	n	Infestation rate (%)
Bayonne	669	8.5
Hackensack	489	5.7
Irvington	359	24.5
Paterson	855	13.8

We invented a bed bug lure (Seizer™) consisting of four chemicals namely, nonanal, 1-octen-3-ol, spearmint oil, and coriander Egyptian oil. It increased trap catch by at least 2.2 times (Singh et al. 2012) (Fig. 7).

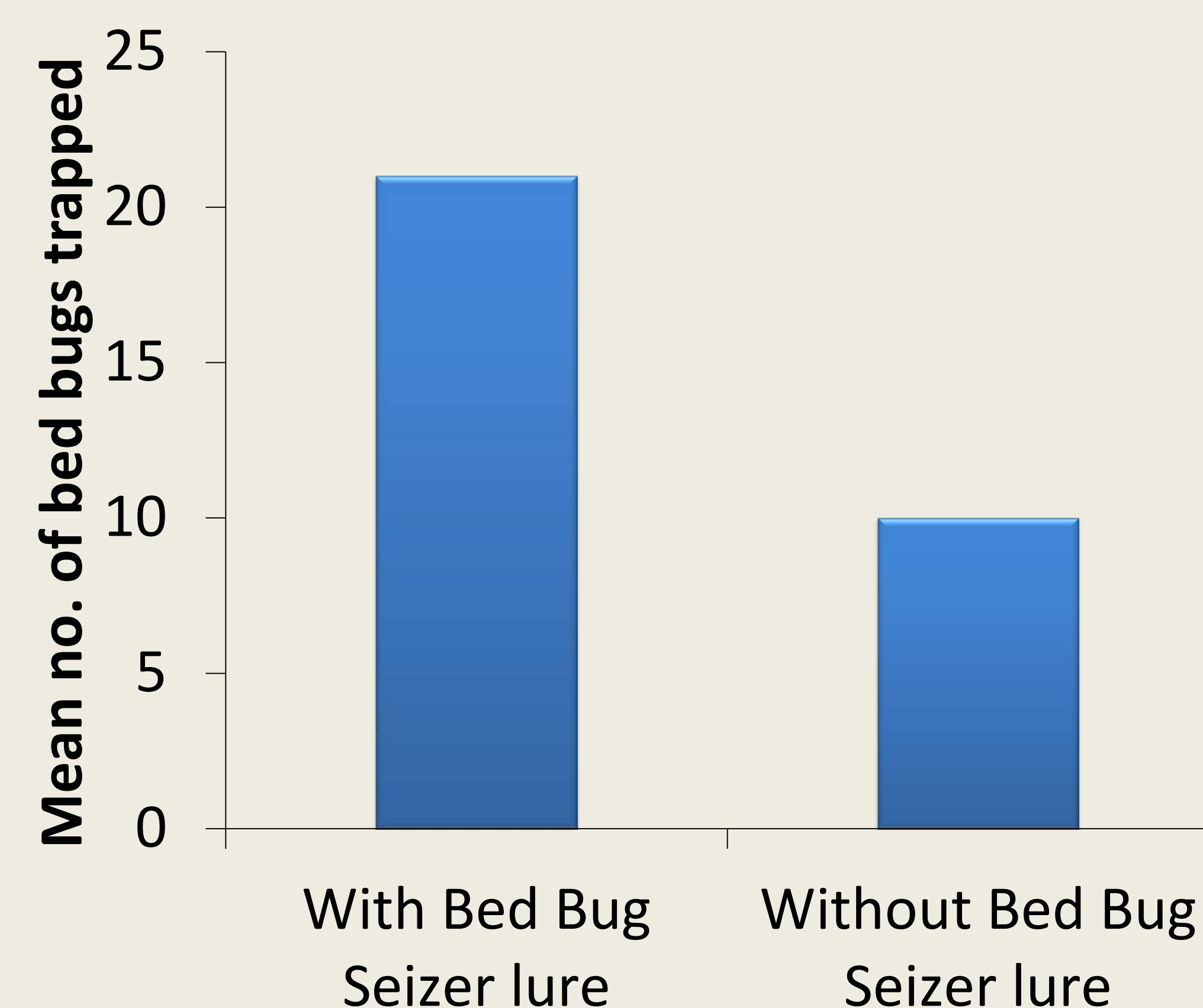


Fig. 7. Effect of Seizer™ lure on trap catch. Data were based on placement of pairs of Climbug interceptors (baited and non-baited) in infested apartments for two days.

New bed bug cases increased rapidly since 2010 (Wang, C., unpublished data) (Fig. 8).

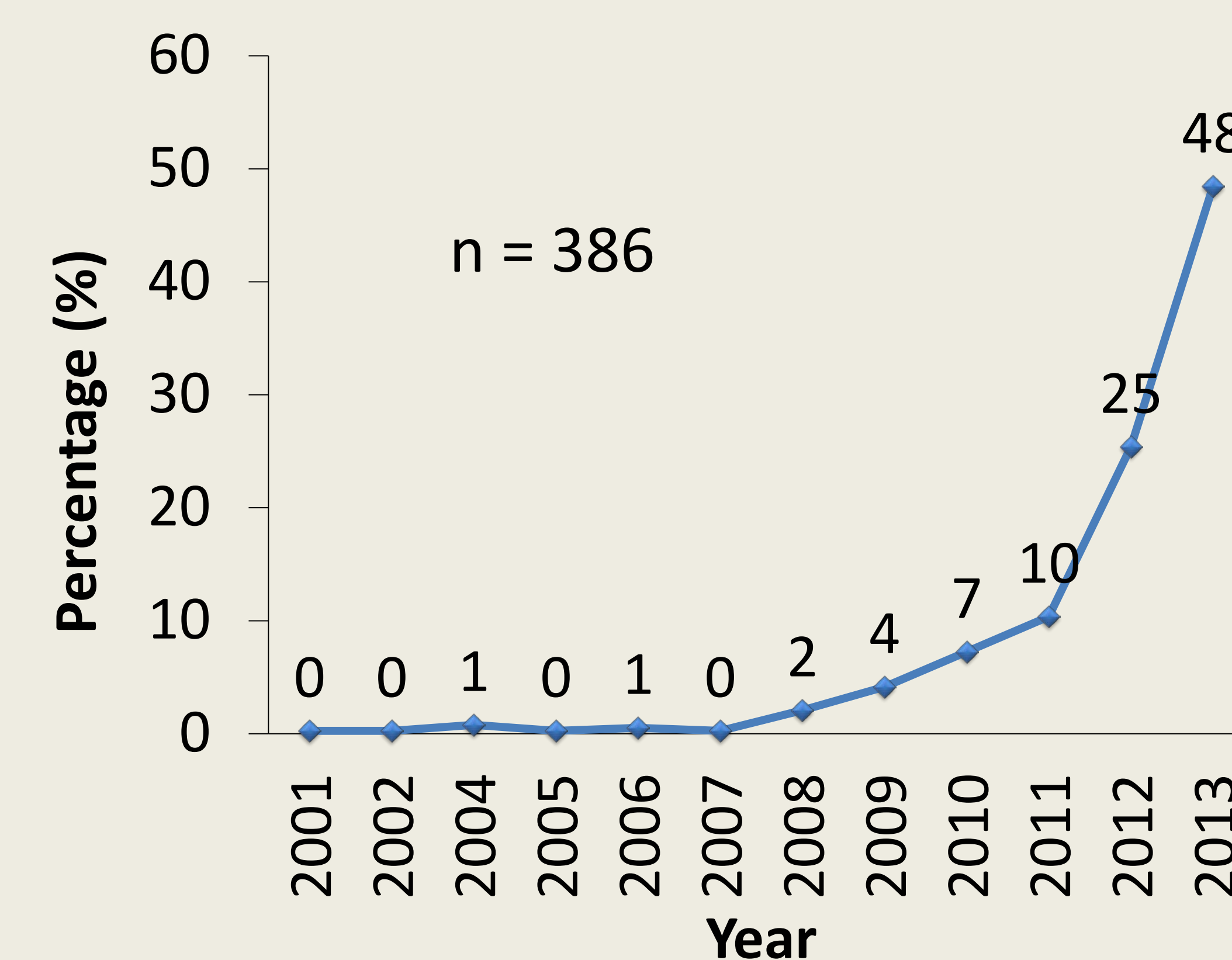


Fig. 8. Patterns of new bed bug infestations in four low income communities in New Jersey.

In field studies, a pitfall trap made from an inverted dog bowl was 2.8 times more effective than Climbug™ Insect Interceptor, the most effective passive monitor (monitor without attractant) in the market. A dry ice and a sugar-yeast monitor were also highly effective for detecting low level bed bug infestations (Wang et al. 2011, Singh et al. 2013) (Fig. 9).



Fig. 9. A) a custom-made bed bug monitor modified from a dog bowl; B) a dry ice monitor consisted of an inverted dog bowl and a thermos containing dry ice; C) a sugar-yeast monitor consisted of a bucket holding sugar, yeast and warm water, two dog bowl traps, and a bed bug lure under the bucket.

Development, implementation, and evaluation of a community-wide bed bug integrated pest management (IPM) program.

This program was conducted in an affordable housing community in Jersey City. Proactive inspections and biweekly treatments until bed bugs were no longer detected after three biweekly monitoring visits were key elements of the IPM program.

RESULTS: A total of 55 bed bug infested apartments was identified during the initial inspection. Property management was unaware of 71% of these infestations. Over the next 12 months, 16 new apartments with bed bug activity were identified, 12 of which were identified through community-wide inspections at 6 and 12 months, 75% went unreported. The IPM program resulted in a 98% reduction in bed bug counts and reduced infestation rates by 82% after 12 months (Cooper, C., Unpublished data).

Discussion

Low income communities are currently experiencing a high rate of bed bug infestations. Lack of financial sources, lack of awareness, poor resident collaboration, and use of ineffective control methods contributed to the chronic and high level of infestations.

Adopting a building-wide bed bug IPM program incorporating proactive monitoring and biweekly treatments of infested apartments utilizing nonchemical and chemical methods can successfully reduce bed bug infestations to very low levels.

Further research, education, and demonstration of cost-effective management methods are in great need to help solve the current bed bug resurgence. Without such efforts, bed bugs will continue to spread and pose increasing financial and health impact to the society.

References

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