

## OCCURRENCE OF BED BUGS IN BUDAPEST, HUNGARY

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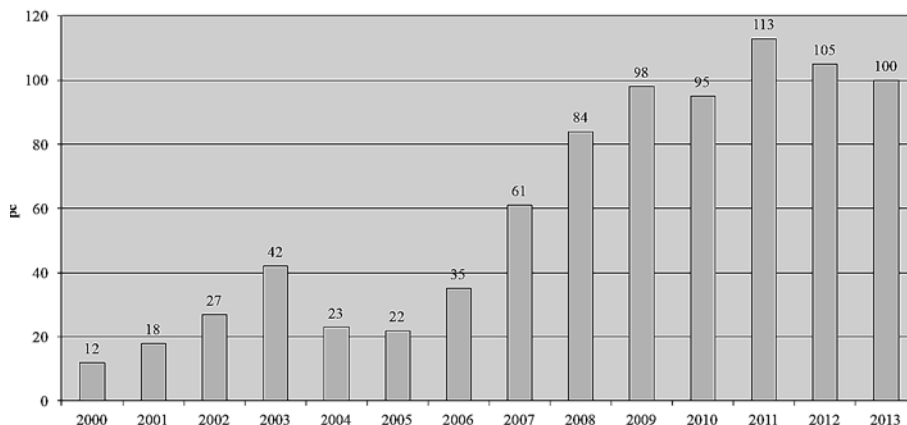
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**Abstract** The number of bed bug controls in Budapest has been steadily increasing since 2000, an abrupt rise, however, began from 2007. To apply an effective control strategy, it is essential to identify the causes of the increase in the number of bed bugs. To determine the causes, during the past one and a half year, simultaneously with the treatments performed by Bábolna Bio in apartments and institutions in Budapest, a questionnaire was also filled out. The survey was conducted over a 18-month period between March 1, 2012 and August 30, 2013 in 91 flats and in 14 institutions, at a total of 105 locations. We surveyed the level of bed bug infestation in the flats, the type of buildings, the layout and the furniture of the flats. We identified the presumed mode of introduction and inquired about how long the tenants had been aware of the presence of bed bugs. In addition, we also investigated signs indicative of bed bugs and their occurrence and location within the flat or room.

**Key words** *Cimex lectularius*, bed bug survey.

### INTRODUCTION

Based on the data available, we can say that the occurrence of bed bugs in Hungary was quite general in the beginning of the 20th century, but their number steadily increased from the 1940-ies. In The Fauna of Budapest, Péntzes (1942) reported that 75% of the apartments in Budapest were infested with bed bugs. At the end of the 1950s, infestations decreased significantly, due primarily to the treatments carried out with hydrocyanic acid and later with DDVP. Between 1970 and 1990 bed bugs remained at a low level, but they began to reappear in the late 1990s both in Europe, the United States and Australia (Boase, 2008; Doggett, 2006; Kilpinen, et al., 2008). The number of bed bug treatments in Budapest performed by Bábolna Bio has been steadily increasing since 2000, with a dramatic increase since 2007 (Figure 1).



**Figure 1.** Bed bug treatments per year by Bábolna Bio in Budapest: 2000-2013.

Researchers in pest control give various explanations for the abrupt increase in bed bugs at certain locations. They attribute the increase to general and partly insecticide-related reasons. General reasons: lack of knowledge or experience, increased traveling activity: tourism and especially the traffic of guest workers worldwide, inappropriate chemical treatments, increased sale of second-hand furniture, junk clearance, neighborhood clean-up, lack of controls and inspections by the authorities, improper pest control practices. Insecticide-related reasons: decrease in the number of insect control treatments by spraying as compared to gel treatments, decrease in the types of insecticide actives available for spraying as a result of the adverse effect of the European Biocidal Products Directive, worldwide resistance to pyrethroids and carbamates (Bajomi et al., 2012; Doggett, 2006; Boase, 2008).

Bed bugs are insects in a hidden habitat with high reproduction potential, and their control is difficult. For an effective control strategy, it is of important to know why bed bugs are increasing. Successful control of bed bugs largely depends on thorough and careful inspection (Papp, 2011).

## **MATERIALS AND METHODS**

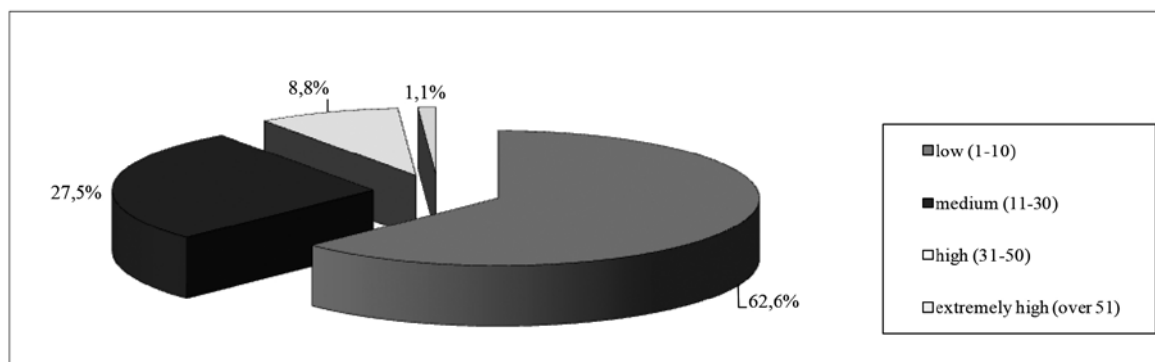
In this presentation we are reporting on the results of a survey conducted by means of questionnaire. During the past one and a half year, simultaneously with the bed bug treatments carried out by Bábolna Bio in apartments and institutions in Budapest, survey forms were also filled out. The survey was conducted in 105 locations between March 1, 2012 and August 30, 2013. We surveyed the level of infestation of the apartments and institutions to be treated, the type of buildings, the layout and the furniture of the apartments. We identified the probable mode of introduction and inquired about how long the people at the location had been aware of the presence of bed bugs. We also investigated signs indicative of bed bugs as well as their location within the apartment or the room. We used a questionnaire for the purpose of the survey.

## **RESULTS AND DISCUSSION**

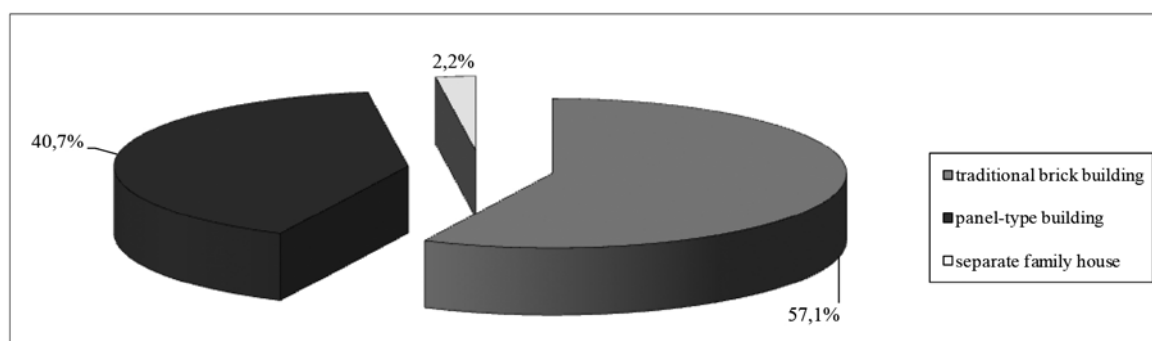
During the inspections and controls performed by Bábolna Bio over the 18-month period, bed bug infestations were detected on 91 occasions (86.7%) in apartments and on 14 occasions (13.3%) in public institutions. We are unaware of the number of pest control companies and the bed bug treatments performed by these companies during this period in Budapest, a city with 1.8 million inhabitants.

When surveying in apartments, and before treatment, the level of insect infestation in the areas to be treated. The goal of each survey was to confirm or to exclude an active bed bug infestation or, in case of an active infestation, to determine its extent. According to the number of bed bugs found in an apartment, four categories were determined: low level (1-10 bed bugs per apartment), medium level (11-30 bed bugs per apartment), high level (31-50 bed bugs per apartment), extremely high level (over 50 bed bugs per apartment). Figure 2 shows various infestations levels of the apartments. Before and during treatments in the apartments, we found low levels in 57 apartments which represent 62.6% of the treated apartments. Medium, high and extremely high levels were detected in 25 (27.5%), 8 (8.8%) and 1 apartments (1.1%), respectively.

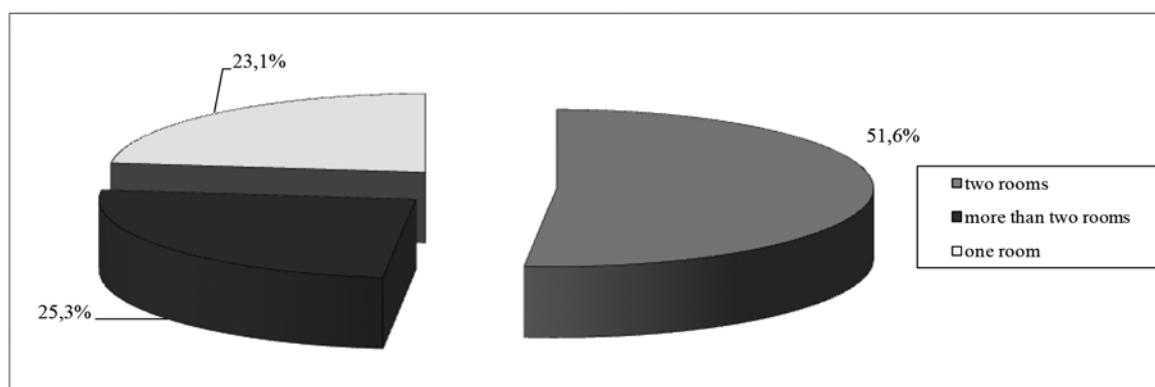
We examined the building technology of the houses and found that more than half of the 91 treatments (52 occasions, 57.1%) were done in apartment buildings, mostly in old brick buildings in the central districts of Budapest (Figure 3). The number of apartments found infested in the panel-type buildings in housing estates was 37 (40.7%). This building technology favors bed bug infestation and active movement or migration of the insects within the building. Infestations in separate family houses were found on only 2 occasions (2.2%).



**Figure 2.** Infestation levels of apartments before treatment in Budapest, Hungary.



**Figure 3.** Ratio of infested apartments by building type in Budapest, Hungary.



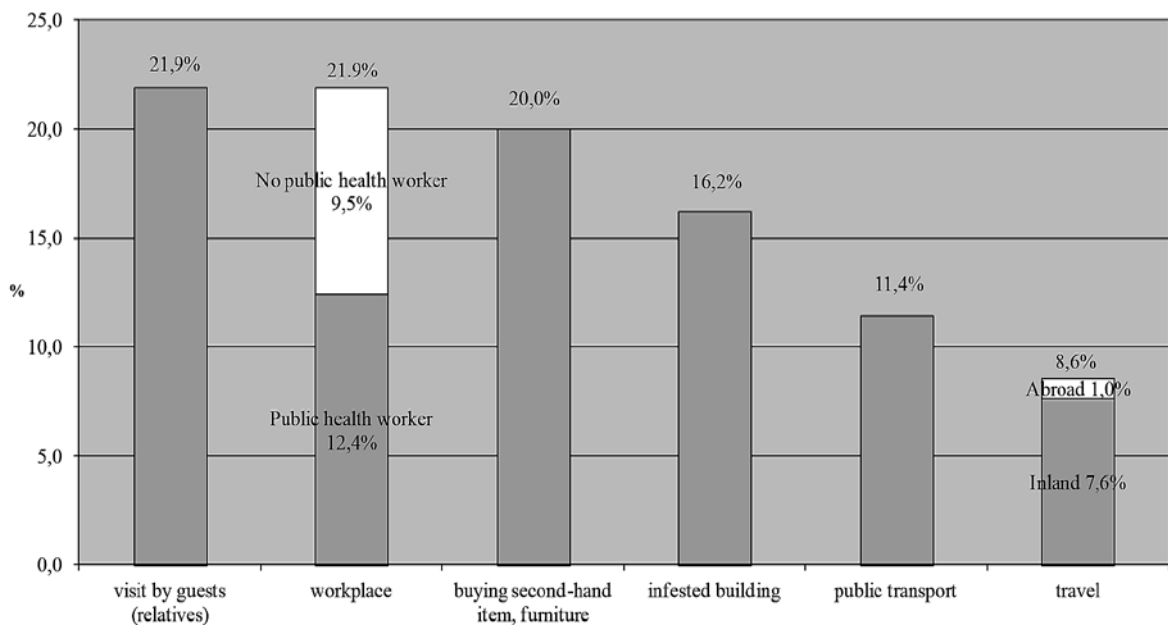
**Figure 4.** Number of rooms in bed bug infested apartments in Budapest, Hungary.

The ratio of bed bug infested multiple-room apartments represented 23.1%, 51.6% and 25.3%, respectively. 4.4% of them had lofts (Figure 4). This is an important element which requires special attention both during the survey and the control works as the wooden structures of lofts provide numerous harborage for bed bugs. The loft spaces had beds installed, and these places proved to be the most infested. 20%, 60% and 20% of bed bug infested apartments were under-furnished, fairly furnished and over-furnished, respectively.

As bed bugs primarily spread in a passive way, we wondered how people living or working in the apartments thought the infestation might have started. Figure 5 shows the presumed modes of

introduction. For the most part (21.9%), people blame visits by relatives or guests for introducing bed bugs to their apartment. 21.9% of the respondents think they might have taken the bed bugs home from their workplace. It is worthy of note that half of them (12.4%) work in the public hygiene sector. 20% of the people inquired believed that infestation started from various articles for personal use and furniture. To obtain food, bed bugs move from one apartment to another mostly along the electric wires, water ducts and gas pipes of the panel-type buildings (Erdős et al., 2002). 16.2% of the tenants think that the infestation originated from their neighbor. Public transport in big cities also provides conditions suitable for bed bugs, and 11.4% of the persons participating in the survey considered this as the possible source of infestation of their apartment. 8.6% of the people associated the infestation with a trip inland or abroad.

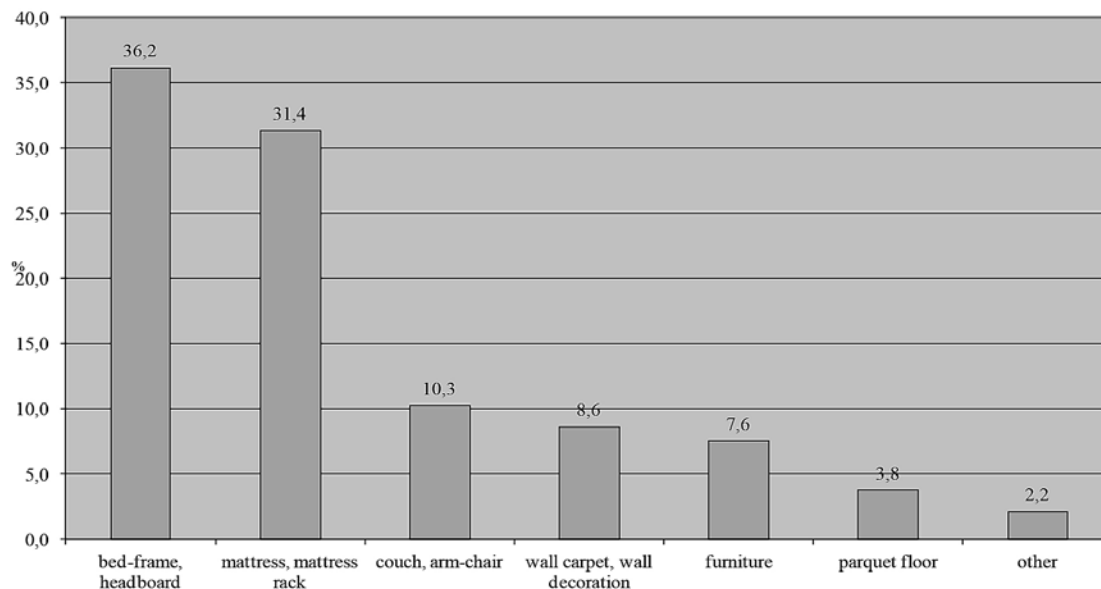
Upholstered furniture, wall coverings, panel-works, loft spaces made of wood, wall-papers, crowded and cluttered apartments make their detection more difficult. Bed bugs leave dark, fluent traces of excrement immediately after feeding. These are often regarded as the first signs of an infestation (Doggett, 2006; Papp, 2011). In case of early infestations, excrement can be found near the bed only. It is advisable to check bedding for the stains of bed bug excrement. These traces may be distinctly visible on the wallpaper or light textile surfaces. As the exuviae remain intact for long, they are not suitable to differentiate between active and older infestations (Madge, 2011).



**Figure 5.** Presumed mode of introduction of bed bugs into apartments surveyed.

Active bed bug infestations are typically indicated by the bites. At 80 out of the 105 surveyed locations, the people living or working there reported bites. During the survey, pest control operators detected live or dead insects on 43 and 16 occasions, respectively, exuviae were found on 3 occasions. The excrement and the distinctive blood-stain denoted the presence of bed bugs in 26 and 23 cases, respectively. In case of minor infestations bed bugs are almost always found in or very close to the bed structure. The next question revealed where the insects were hiding within the apartment (Figure 6). In 67.6% of the cases (125) they were found close to the bed or immediate surroundings. Bed-frames and

headboards represented 36.2% (67 cases), mattresses and mattress racks account for 31.4% (58 cases). The remaining 32.5% occurrence (60 cases) was divided as follows: couch, armchair 10.3% (19 cases), wall carpet, wall decoration 8.6% (16 cases), furniture 7.6% (14 cases), parquet floor 3.8% (7 cases), other locations 2.2% (4 cases).



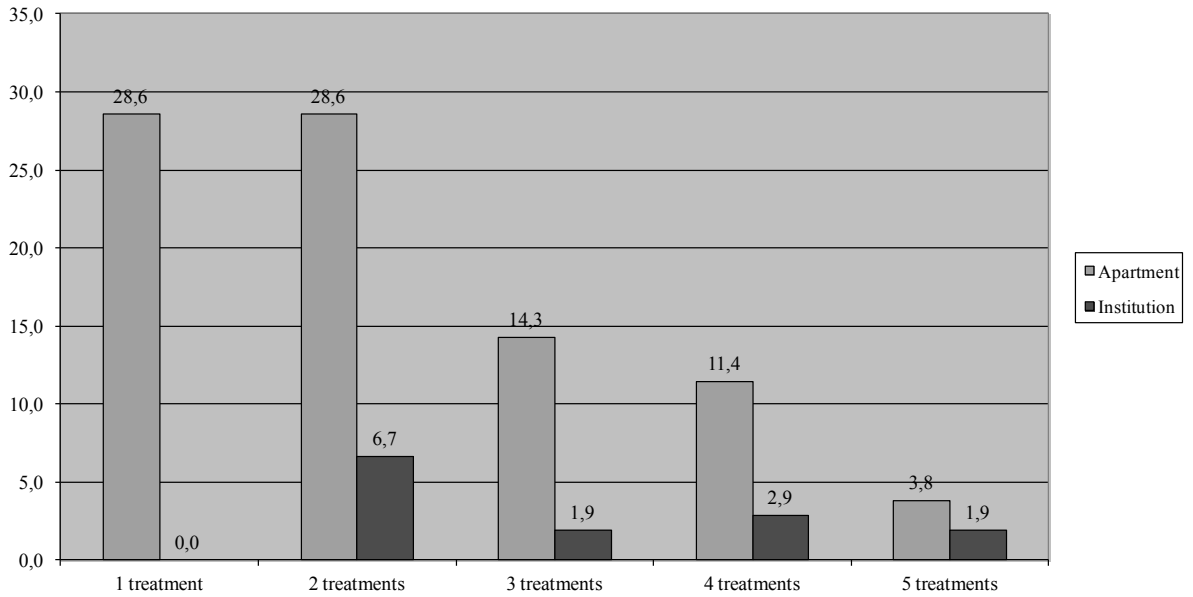
**Figure 6.** Occurrence of bed bugs in apartments surveyed.

Comparison of these data to the surveys made by the University of Kentucky in apartments in the United States reveals the similarities summarized in Table 1. The data in the table clearly show that the most infested spot in the rooms are the bed and its immediate surroundings. This is confirmed by both surveys: Bábolna Bio: 67.6%, University of Kentucky: 71.8%. About 30% of the bed bugs can be found further off the bed in any part of the rooms. This information is very important during control.

## CONTROL

Bed bug control was mainly carried out by using Biopren 6 EC. The product has rapid flushing out and killing effect, low toxicity and can be applied to various textile surfaces including mattresses. The flushing out and the rapid killing action is ensured by the synergised natural pyrethrum, while the S-methoprene is responsible for disruption of the growth of eventually surviving larvae. The insect growth regulator active ingredient of the S-methoprene disrupts the life cycle of the insects by preventing their metamorphosis into adults (Bajomi, et al., 2011; Bajomi, et al., 2012).

In the highly infested places a residual insecticide (containing cifenotrin and d-tetramethrin active substance) was simultaneously used by adding to the working solution prepared with Biopren 6 EC (tank mix). In 28.6%, 35.2% and 16.2% of the total of 105 infested locations the bed bug infestation was eliminated with only one, two and three treatments, respectively. In 14.3% of the cases, an additional treatment (four in total) was necessary. 57.2% of the apartment bed bug infestations could be eliminated with one or two treatments. In locations with extremely high infestation five treatments were necessary but this represents only 5.7% (Figure 7).



**Figure 7.** Number of treatments to control of bed bugs in apartments and institutions

It is worth examining the relation between the number of insecticide treatments necessary to achieve bed bug control and the initial insect infestation. We examined the initial level of bed bug infestation in those apartments where four or five treatments were necessary for the total elimination of bed bugs (Table 2). From these data one cannot establish a close relation between the initial infestation level and the number of treatments. There were cases when four treatments had been performed even if the initial infestation was low or medium. When five treatments proved to be necessary, the initial infestation was extremely high in one case only, while on the other three occasions it was medium. It is possible that the crowdedness of the apartments or the re-infestation during the treatments have a bigger role in terms of the number of treatments necessary to achieve full elimination than the initial bed bug infestation. Consequently, it can be declared that appropriate formulations and methods for bed bug control are available.

**Table 1.** Surveys of places bed bugs occurred during treatments.

Locations	Bábolna Bio Ltd. %	University of Kentucky %
Bed-frame, headboard	36.2	13.4
Mattress, mattress rack	31.4	57.0
Couch, armchair, easy-chair	10.3	22.6
Wall carpet, wall decoration, walls/ ceiling	8.6	2.3
Furniture	7.6	---
Other (parquet floor, etc.)	6.0	3.0
Wood slats	---	1.4

**Table 2.** Level of bed bug infestation in apartments and the number of treatments necessary to achieve bed bug free conditions.

Number of treatments	Initial Infestation Per Apartment			
	Low (1-10)	Medium (11-30)	High (31-50)	Extremely high (over 50)
4 treatments	3	6	3	0
5 treatments	0	3	0	1

## CONCLUSIONS

The survey conducted in Budapest was the first ever attempt to obtain an objective picture of the existing infestation during bed bug control treatments. It can be definitely stated that the presence of bed bugs in Budapest, in line with international tendencies, has been gradually increasing over the last decade, but an abrupt increase occurred in 2007.

The survey shows that the great majority (90.1%) of the 91 apartments had low or medium bed bug infestation level at the time of the survey. Contrary to what had been expected, bed bug infestations in Budapest were more frequently (57.1%) found in traditional buildings made of brick than in panel-type buildings in housing estates. This confirms that bed bugs spread mainly by way of introduction instead of active migration.

Based on our findings, visits by guests or relatives, take-away from workplace, purchase of second-hand furniture, infestation on means of public transport or during travels play a major role in terms of bed bug introduction. It is especially worthy of note how often persons working in public hygiene take bed bugs home. The occurrence of bed bugs within the apartments is closely associated with beds (67.6%), (mainly upholstered) furniture (17.9%), walls and wall decorations or cracks in the parquet floor (12.4%).

In the majority of cases, the insecticide spray containing natural pyrethrum and S-methoprene IGR, occasionally complemented with residual cifenotrin tank mix, achieved total elimination with two or three treatments (63.9% and 16.2%, respectively). We did not find close relation between four or five treatments performed at the same location and the initial level of infestation.

For a successful control, performance of an initial inspection and a thorough control done with the utmost diligence seem to be more important. Success definitely requires close co-operation with the tenants or owners of the premises. Experience shows that bed bug infestations can be eliminated with the insecticides and methods that we have available.

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