

Laboratory Evaluation of the Stability of Gel Bait with Active Ingredient Fipronil against *Periplaneta Americana*

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Abstract

To evaluate the fipronil stability of gel bait with active ingredient fipronil against *Periplaneta Americana* (*P. americana*) under high temperature condition, the gel baits were heated at 55°C for 24h, 48h and 7days respectively. The toxicities of treated baits against *P. americana* were evaluated for comparing the toxic varieties under high temperature condition. Result showed that, the efficiencies of fipronil gel baits treated at 55 °C for 24 hours, 48 hours, 7 days were no significant difference over untreated group. It could keep stable efficacy under high temperature condition and was suitable for use in controlling *P. americana*.

Keywords: gel bait, stability, fipronil, *P. americana*.

1. Introduction

The cockroaches are one of the most serious food and residential pests worldwide. It is found mainly in buildings, restaurants, bakeries, basements, sewers, steam tunnels, and drainage systems. They can develop to enormous numbers, greater than 5,000 sometimes being found in individual sewer manholes. *Periplaneta Americana* (*P. americana*) is an omnivorous found eating paper, boots, hair, bread, fruit, book bindings, fish, peanuts, old rice, putrid sake, the soft part on the inside of animal hides, cloth and dead insects. However, *P.americana* also important insect vector, it is generally transmit many pathogens such as viruses, fungi, bacteria, protozoa and helminthes that are harmful to human health.

The major controls of *P.americana* are based on the chemical insecticides such as organophosphate and pyrethroids insecticides. The Goliath gel formulation of fipronil is approved for use in a number of countries as bait to control cockroach infestations. Fipronil was reported to be a highly effective insecticide, utilizing a low-dose technology, against both piercing-sucking and chewing agriculturally important insect pests, and can be delivered via soil, foliar, bait or seed treatment applications. However, no information is presently available on the stability of gel bait with active ingredient fipronil against *P.americana* under high temperature condition.

The present study was conducted to evaluate the effectiveness of a bait station containing 0.05% fipronil as the active ingredient against *P.americana* under high temperature condition. Evaluate the toxic efficacy of *P.americana* and to compare the toxic varieties under high temperature condition. This

information will be helpful for us to choose better formulated bait and its ability to suppress populations of *P.americana* was assessed.

2. Materials and methods

The cockroaches were obtained from Anhui Zhongyu insect breeding base, China. Maintained in the laboratory for 14 days, was used in these experiments. Both cockroach strains were provided water and dog chow ad libitum, the colony was maintained at $25\pm 2^{\circ}\text{C}$, ambient relative humidity ($70\pm 10\%$) with a 12-hour light and 12-hour dark.

Baits were prepared by Liuzhou WanYou Pest Control Research Institute. A single bait matrix was used in all experiments. This matrix was formulated with either 0.05% fipronil. Baits were evaluated in glasses containers ($20\times 50\times 36\text{cm}$), each provisioned with a cardboard harborage preconditioned for 3d in cockroach rearing containers, a water bottle, and feeds. Thirty male cockroaches were placed in each container and allowed to acclimate 3d before bait placement. Five groups to evaluation the efficacy experiments were room temperature, 55°C placed 24h, 48h and 7d of 0.05% fipronil cockroach gel bait, untreated group and a control group, normal feeding (only provide feed and water). The mortality of the cockroaches was observed and recorded hourly unit 12 hours for the first day, and every 12 hours for another 12 days and at each count any dead insects were removed from the containers. Each groups have the selective and non- selective experiment and repeated 3 times.

3. Statistical analysis

The number of dead cockroaches was recorded. The results are expressed as mean \pm SD for analysis performed in triplicate, and the results were expressed as mean \pm SD. The mean values and standard deviation were calculated with the Excel program from Microsoft Office 2007 package. A value of $P\leq 0.05$ was considered to indicate statistical significance.

4. Results

The mortality rates for the gel baits were heated at 55°C for 24h, 48h and 7days, control group, untreated group respectively against *P. americana* are shown in Fig. 1. (The efficacy of selection) and Fig. 2. (Non-selective).

No mortality was observed in control group devoid of insecticide but containing feces. The mortality rates for the gel baits were heated at 55°C for 24h, 48h and 7days, control group, untreated group against *P. americana* increase with the prolonging of time. In two choice experiments, untreated group was able to induce 100% mortality of *P.americana* within 10 days (< 10 days), and the gel baits were heated at 55°C for 24h, 48h and 7days, induce 100% mortality of *P.americana* within 11 days (< 10 days). All the gel baits showed significant difference over control group (negative control) ($P<0.05$). The efficiencies of fipronil gel baits treated at 55°C for 24 hours, 48 hours and 7days showed no significant difference over untreated group (positive control) ($P>0.05$). The results showed that fipronil gel bait had good efficacy against cockroaches. It could keep stable efficacy under high temperature condition and was suitable for use in controlling *P. americana*.

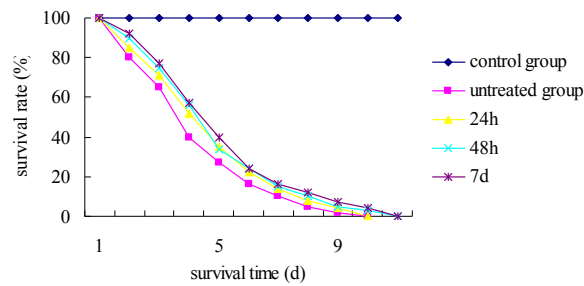


Fig. 1. Percentage mortality (survival rate) against P.americana with the selective

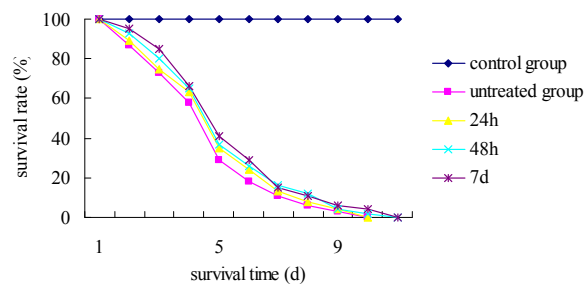


Fig. 2. Percentage mortality (survival rate) against P.americana with the non-selective

5. Conclusion

Bait station containing fipronil 0.05% w/w was able to induce 100% mortality of P.americana within a short period (< 11 days) by direct application in this study. The fipronil stability of gel bait with active ingredient fipronil against P.americana under high temperature condition, the gel baits were heated at 55°C for 24h, 48h and 7days, its palatability and virulence have not been significantly affected. This study shows that fipronil cockroach gel bait has excellent efficacy and stability; it is Suitable for against cockroaches under high temperature conditions.

Acknowledgements

This work was financially supported by National Undergraduate Training Programs for Innovation and Entrepreneurship (201310594016).

References

- [1]. Ali, F. A. F., El-Refai, A., Abdel-Rahman, et al. Effects of insecticides and environmental factors on the behaviour of cockroaches in Ebling choice-boxes. *J. Econ. Entomol.* Vol. 78, Issue 6, 1985, 607-612.
- [2]. Apel, A. G., Benson, E. P., Ellenberger, et al. Laboratory and field evaluations of an entomogenous nematode (Nematoda: Steinernematidae) for German cockroach (Dicoptera: Blattellidae) control. *J. Econ. Entomol.* Vol. 86, Issue 7, 1993, 777-784.
- [3]. Ahmad FBH, Mackeen MM, Ali AM, et al. Repellency of essential oils against the domiciliary cockroach, *Periplaneta americana*. *Insect Sci. Appl.* Vol. 16, Issue 3/4, 1995, p. 391-393.
- [4]. Cotton MF, Wasserman E, Pieper CH, et al. Invasive disease due to extended spectrum beta-lactamase-producing *Klebsiella pneumoniae* in a neonatal unit: the possible role of cockroaches. *J. Hosp.*

- Infect.* Vol. 44, Issue 1, 2000, p. 13-17.
- [5]. Colliot F, Kukorowski KA, Hawkins DW, et al. Fipronil: a new soil and foliar broad spectrum insecticide. Brighton Crop Protection Conference-Pests and Diseases. Vol.2, Issue 1, 1992, p.29-34.
- [6]. Kristensen M, Hansen K., Klingenberg J, et al. Cross-resistance between dieldrin and fipronil in German cockroach (Dictyoptera:Blattellidae). *J. Econ. Entomol.* Vol.98, Issue 8, 2005, p.1305-1310.
- [7]. Flattum, R.F., Sternburg, J.G. Active materials by nicotin in the central nervous system of American cockroaches. *J.Econ.Entom.* Vol.63, Issue 1, 1970, p.67-70.
- [8]. Tine S, Aribi N, Soltani N. Laboratory evaluation of azadiractin against the oriental cockroach, *Blatta orientalis* L. (Dictyoptera, Blattellidae): Insecticidal activity and reproductive effects. *Afr. J. Biotechnol.* Vol.85, Issue 10, 2011, p.19816-19824.
- [9]. Valles, S. M., P. G. Koehler, and R. J. Brenner. Antagonism of fipronil toxicity by piperonyl butoxide and S, S, S-tributyl phosphorotrithioate in the German cockroach (Dictyoptera: Blattellidae). *J. Econ. Entomol.* Vol. 90, Issue 10, 1997, p.1254-1258.