Lesser mealworm, *Alphitobius diaperinus* (Panzer, 1797) (Coleoptera: Tenebrionidae) menace in poultry farms in south India

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ABSTRACT

Alphitobius diaperinus (Panzer, 1797) (Coleoptera: Tenebrionidae), commonly known as the 'lesser mealworm', a major insect pest in the poultry industry and a premise pest in grain storage is of importance as an avian disease vector due to its capability of transmitting avian diseases. The present work reports presence of *A. diaperinus* in poultry manure and poultry houses in south India. Review reveals development of insecticide resistance and bioaccumulation of insecticide residue in poultry meat in addition to the health hazards that makes control with insecticides undesirable. Our analysis revealed that keeping the litter in open areas in agricultural fields did not lead to death of the beetle instead it serves as a potential source of dispersal and re-infestation.

Key words: *Alphitobius*, lesser mealworm, poultry manure

INTRODUCTION

The lesser mealworm, *Alphitobius diaperinus* (Panzer, 1797) (Coleoptera: Tenebrionidae) is a common cosmopolitan insect pest of poultry farms where they often occur in large numbers in the bedding litter material that is used on the floor (Tomberlin *et al.*, 2008). The beetles affect bird performance when consumed by poultry and have been implicated in the transmission of over thirty avian diseases including turkey corona virus (TCV) (Despin *et al.*, 1994). Chickens feeding on beetle larvae show poor weight gain and increased mortality (Chernaki-Leffer *et al.*, 2010).

High incidence of *A. diaperinus* was noticed in the poultry manure reaching Kerala from Tamil Nadu during the search for the nuisance pest in rubber plantations, *Luprops tristis* (Fabricius, 1801). It led to the proposition that poultry farms in Tamil Nadu as well as in other parts of the country are likely to be infested with *A. diaperinus*. Farmers often keep the poultry manure infested with *A. diaperinus* in the open to kill the beetle. The present study was carried out to verify the presence of *A. diaperinus* in the poultry farm belts in Tamil Nadu as well as to check whether the field dumping of poultry manure leads to death of *A. diaperinus*.

MATERIALS AND METHODS

Beetles were collected by handpicking and sifting poultry litter from ten poultry farms at Dindigul district of Tamil Nadu state during May 2011. They were identified with the keys in Dunford and Kaufman (2006) and Mathews and Bouchard (2008) and by comparing with verified specimens in the Coleoptera collections in our institution. Forty beetles each were transferred to 20 earthen vessels laid with the poultry bedding litter. Ten vessels each were kept in open area in the middle of an agricultural field and an unused shed. Activities were checked on a daily basis and the mortality of beetles were recorded till 50% of mortality was reached in either of the set ups.

As the data sets were normally distributed, parametric statistics were used for comparison of the data. Variations in mortality among samples were analysed with one-way ANOVA test (Weiss, 2007). For all analyses, significance was determined at $P<0.05$. Minitab Statistical software version 16 was used for all statistical analysis.

RESULTS AND DISCUSSION

Incidence of *A. diaperinus* in the poultry farms

Five of the ten farms showed massive beetle invasion at the rate of 200 beetles per square meter. The farms devoid of beetle invasion were well managed and treated with insecticides and fumigants as the farm owners were aware of the ill effects. Infested farms were poorly maintained and not treated likewise. The owners of such poultry farms were ignorant of the damages caused by the beetle and their larvae. Their ignorance necessitates steps to create awareness about the pest and to adopt control measures. The present

Table 1. Mortality of *A. diaperinus* (n=40 per sample) kept in the unused shed and in the open agrifield

Sample	No. of days taken for 50% Mortality in unused shed	No. of days taken for 50% Mortality in agri field
1	5	15
2	6	14
3	6	14
4	5	16
5	5	14
6	5	16
7	6	15
8	5	16
9	5	15
10	6	14
Mean value	5.4	14.9

documentation of *A. diaperinus* in poultry farms in the country in general requires immediate studies to assess the extent of infestation of the pest in poultry farms across the country before it becomes unmanageable.

Field dumping of poultry waste as a control measure

Beetles kept in the open agri field recorded low mortality (mean ±SD) and those kept in the unused shed (mean ±SD) showed high mortality ($F=873.39$, df 1; $P<0.05$). Mean of number of days taken to reach 50% mortality was 14.9 in the agri field and 5.4 in the unused shed (Table 1). Comparison between the numbers of days taken for 50% mortality between the two showed normal distribution and analysis with one way ANOVA showed significance ($F=873.39$, df 1; $P<0.05$). Beetles kept in the open agri field recorded low mortality and those kept in the unused shed showed high mortality (Mean of number of days taken to reach 50% mortality being 14.9 in the agri field and 5.4 in the unused shed). Comparison between the numbers of days taken for 50% mortality between the two showed normal distribution and analysis with one way ANOVA showed significance ($F=873.39$, df 1, $P<0.05$).

According to the data, beetles kept exposed in the open condition did not die. Instead, they dispersed and hid behind logs and stones whereas those kept indoors did not move out. This indicates that keeping the beetles in the open environment did not lead to their death rather it leads to their mass dispersal to nearby farms or residential areas (Calibeo, 2002). Hence, only beetle free poultry manure should be used as manure in the agri fields. Deposition in the open field would contribute towards population build up of the beetle and their spread into the grain storage homes, infestation of unaffected poultry farms and dispersal across the region.

Control Measures

A management program involving litter and premise treatments at cleanout followed by regular monitoring and baiting can provide partial suppression of beetle populations in broiler and turkey houses (Lambkin, 2005). Common litter management practices include the removal of used poultry litter as organic fertilizer. Frequent litter removal reduces beetle populations within poultry houses but serves as a potential source of dispersal and re-infestation (Calibeo, 2002). Several formulations of carbaryl, lime hydrate, pyrethroids and insect growth regulators are used for chemical control. Insecticide treatment is normally carried out in poultry farms during clean-out cycles after litter removal and before introduction of the new flock. However, many of these insecticides used have been either banned or are no longer in use. Litter treated with alum and shredded paper litter treated with boric acid reduced beetle populations in broiler houses (Worley *et al.*, 2000). Insecticide treatment can be deleterious since there are chances of those chemicals reaching meat and later getting biomagnified in the food chain. Current standard industry insecticides are not effective when applied to broiler house floors, a situation exacerbated by strong and widespread insecticide resistance occurring in broiler house beetle populations (Calibeo, 2002). Meat chicken industry at global level has been concerned in recent years over the inadequacies of current control practices and research effort to develop acceptable control stratagems for *A. diaperinus* is progressing (Lambkin, 2005). Even though crude extract of the botanical insecticide neem was found to be effective against beetles (Azmi *et al.*, 1993), no thorough verification of neem or other biopesticides had been done. Further research is needed to determine whether natural enemies or

biopesticides can be developed into practical management tools for use in IPM programs.

ACKNOWLEDGEMENTS

Financial assistance provided by Department of Science & Technology (DST), Government of India is gratefully acknowledged.

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Received: 11.03.2012 Revised: 19.04.2013 Accepted: 31.5.2013