Preferences of Indian Meal Moth Larvae for Different Dog Foods

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Abstract

Indian meal moths (IMM), *Plodia interpuntella,* are persistent pests to our foods (Fasulo et al.1998; Plunkett's Pest Control 2018). When IMMs infest a a food product the resulting value loss is the result of contamination by larvae that leave droppings and silken webs in grain and grain products (Jacob and Calvin 2001). The IMM is an important pest of high-value dog foods and the grain components of these food may influence their infestation. Experiments were conducted with eggs of the IMM to determine if moth larvae would choose and infest the grain-based dog food in comparison to dog foods with a higher meat content. IMM laboratory rearing diet was included for comparison. No-choice and choice tests confirmed the IMM diet to be the most preferred and best for larval development. Forced infestation of 50 IMM eggs on the four different dog foods found difference among them. In two-choice test that require newly hatched larvae to walk to and infest either lab diet or a dog food, the highest proportion of larvae selecting any of the dog foods was on product C, which was a medium quality, grain-free food. These results suggest that IMM infestations in warehouses or consumer's homes could be prevalent on some dog foods more than others.

Purpose

The purpose of this research was to determine if newly hatched larvae of the IMM differ in their abilities to select and infest a variety of commercial pet foods.

Questions, Hypotheses, and Predictions

Question: How will the small variation among dog foods affect food location and feeding preference of Indian Meal Moths?

Hypothesis: The Indian Meal Moth will find and develop better on grain-based dog food, as represented by product A in this study.

Prediction: With Indian Meal larvae eating grain, we predict they will favor the higher quality grain-based dog food.

Study System

The Indian Meal Moth (IMM), *Plodia interpunctella*, is a pest of stored grains and grain products. IMM is highly adapted to human-stored dried foods. IMMs can infest spices, animal foods, grains, dried fruit and seeds. Yong larvae can infest many types of food packages (Jacobs and Calvin 2001). Females can lay up to 400 eggs in a lifetime (Figs. 1 and 2). Eggs are laid close to food source presumably so larvae do not have to go far (Sambaraju et al. 2016). The most harmful things about the IMM is their ability to get into stored products and damage them by their feeding and webbing of larvae.

Fig. 1, left, Adult IMMs in copula; Fig. 2, IMM eggs

Methods and Experimental Design

Two sets of experiments were conducted, one as a forced infestation to determine relative quality of the foods for IMM development, the second being a behavioral two-choice experiment to see if newly hatched IMM larvae had a preference for one food more than another. Dog food was ground in a blender to a particle size ranging from 2mm to 4mm so the IMM larvae could easily infest the food and not be hindered by the large hard kibble of the original product (Figs. 3, 4, 5 and 6). The ground pet foods also had similar particle sizes to that of the IMM lab diet (Fig. 7). The four dog foods consisted of product A which is a high quality that has grain, product B will be a lower quality grain-based, dog food. Product C will be a medium quality food that is grain free. Product D was a high end, grain-based, specialized food for dogs with liver illnesses. We placed 25 g of each of the four dog foods and of the IMM diet separately into 3 glass 120 ml Mason jars (Figs. 3-7), thus having three complete replicates of the 5-foods, for forced infestation studies. Each jar was inoculated with 50 IMM eggs harvested from adult colonies (Sambaraju et al. 2016) and larvae in each jar were counted after 28 days. Two-choice bioassays used rectangular plastic tubs (Fig. 8, 30 cm long X 10 cm wide X 15 cm tall) to which 50 eggs were put in the middle of the tub floor; a test dog food on one side and the IMM lab diet on the other side. Newly hatched larvae needed to traverse at least 12 cm to either of the foods. The larvae would then make the decision of which food they choose to feed and develop on. Jars for the forced infestation and plastic boxes for the two-choice studies were placed in a growth chamber kept at 25°C and 50% RH with a L:D photoperiod of 16:8.

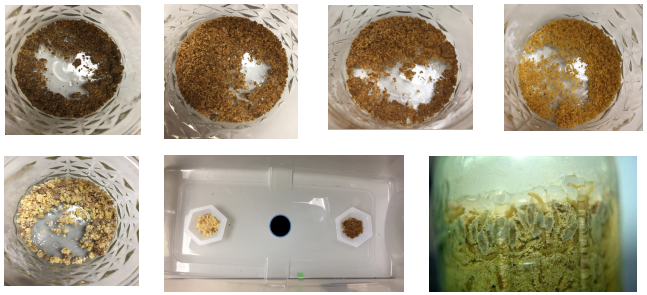

Fig. 3-6, top, left to right, ground experimental dog foods A, B, C and D. Fig. 7, bottom, left , IMM lab diet. Fig. 8, bottom middle, plastic box used in 2-choice assays, viewed from top, with lab diet on left and dog food on right; black circle is where eggs were deposited prior to hatching. Fig. 9, bottom right, a laboratory colony of IMM showing mature larvae like those counted at the end of our no-choice and two-choice studies.

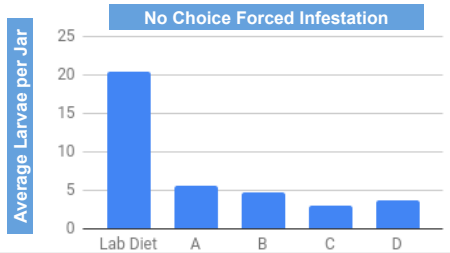

Fig. 10. Average number of larvae produced per jar 28 days after addition of 50 IMM eggs.

Results

No-choice forced infestation trials clearly showed that the IMM lab diet was the most suitable for growth and development of IMM compared to tested dog foods, as expected, with an average of 20.5 larvae per jar (Fig. 10). Larvae produced in the four dog foods had similar numbers with food A having the most with an average of about 6 larvae per jar. The two-choice experiment also had most larvae produced in the IMM diet, but the proportion of all larvae that were in dog food was highest for dog food C, which was at least twice the proportion of larvae in the other three dog foods (Fig 11).

Conclusions

These experiments confirm that IMM larvae can walk a certain distance to find suitable food material to infest. Our two-choice studies suggest that certain commercial dog foods could be infested at higher levels than others.

Future Directions

The nutritional quality of a pet food could play an important role in its risk of infestation. Future research could have experiments in which the concentration of particular nutrients are varied in a standard diet to determine which nutrients might influence the risk of infestation.

References

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