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Effect of Dietary Diatomaceous Earth and a Single Topical Application of Barn Fresh on House Fly, Musca domestica L., Breeding, Egg Quality and Selected Manure Nutrients

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During the period of 3 May to 29 August 2001, studies were conducted in caged layer operations in the lower Fraser Valley region of British Columbia with the aim of evaluating 1) the effect of dietary diatomaceous earth (DE) on fly breeding, egg production, egg quality, and litter nitrogen and sulfur content, 2) the efficacy of a single large topical application early in the fly breeding season or during an outbreak and 3) the effectiveness of Pyrethrins formulated with DE against house flies. The objective of the investigation was to make the use of DE for fly management more practicable by either making it easier to apply by feeding it through the birds, reducing application frequency, or increasing it's effectiveness using a natural pesticide. Although the primary objective was to develop a fly control product, the effect of dietary DE on yield, shell quality and manure quality were also monitored.

Diatomaceous Earth Feeding Trials

Materials and Methods

DE feeding studies were conducted in two identical deep pit caged-layer barns separated by a storage and office areas but connected by a corridor. Manure accumulated in three separate pits, each covering an area of 130 m^2 and was cleaned out on the week of 25 February 2001. The control barn (to the East) housed 10 070 birds while the treatment barn (to the West) housed 9 170 birds that were 48 weeks old at the start of dietary inclusion of DE. Fly populations were monitored twice weekly by hanging 100cm^2 - speck cards 30 cm above the manure for a specific period of time. We have found this manner of placement provides a better index of the fly populations and their breeding potential especially when populations are small. Monitoring was started on 3 May 01, DE feeding was started on 29 May at 2% level and monitoring continued till 7 August 01. At least three cards were placed in the same positions in each barn during a monitoring session. The number of fecal and regurgitate spots left on the cards was later determined and normalized to a 5 hour exposure period. Means of spot count per 100 cm^2/5 hours were subjected to Student t-test to determine if fly populations in DE-fed birds declined significantly faster that for control birds.

Results

Mean numbers of spots during each monitoring day are shown in table 1 below. At the start of DE feeding, the mean spot count was 4363.33 (± 1752) in the DE barn whereas the control barn had only 1505 (± 415.58), less than half the population in the DE barn. By 3 July, there were significantly more flies in the control barn (122.08 ± 18.61) than in the DE barn (12.91 ± 10.52).

Mean differences in fly populations between 29 May 01 (the start of DE feeding), and subsequent monitoring dates are shown on table 2 below.

Table 2. Mean (± S.E.) Differences Between Initial And Final Fly Populations

PERIOD	MEAN (± S.E.) CONTROL	MEAN (± S.E.) D.E.	DF	Prob > |t|	F RATIO
29 May to 14 June	1205.00 (± 197.0)	3725.67 (± 197.0)	4	0.1800	2.6322
29 May to 19 June	1109.45 (± 390.5)	4000.15 (± 1793.5)	4	0.1894	2.4939
29 May to 21 June	1161.11 (± 174.8)	4330.84 (± 1750.2)	4	0.1459	3.2479
29 May to 6 July	1441.91 (± 369.6)	4341.67 (± 1742)	4	0.1788	2.6517
29 May to 26 July	1490.83 (± 416.4)	4360.42 (± 1752.7)	4	0.1864	2.5374

The larger magnitude of fly population decline in the DE barn relative to the control barn indicates some effect on breeding. Chart 1 below shows percent decreases in fly populations in both barns.

Overall these results indicate that fly populations were reduced to a greater extent by DE feeding compared to decline observed for birds that were not fed DE. More trials are needed to confirm these results.

Flock Performance Before and During DE-Feeding

Materials and Methods

To compare performance of DE-fed and control birds, daily egg production for each barn was recorded and averaged as eggs per bird/week. Other parameters including livability, body weight, barn temperature, feed consumption, feed conversion ratio and water consumption were also recorded and statistically analyzed to determine whether they significantly differed before and during DE feeding. Egg size and shell thickness were measured on 25 May, before DE inclusion, and on 12 June, two weeks after the start of DE feeding. Egg size was measured using a veneer calipers and shell thickness with a micrometer screw gauge for a sample of 36 eggs per barn.

Results

Eggs collected from DE – fed birds had significantly thicker shells (0.394 ± 0.014 mm) two weeks after the start for feeding compared to the thickness of eggs collected from the same flock 4 days before the start of DE feeding (0.358 ± 0.0109 mm). Table 3 below shows the results of shell thickness determinations.

Table 3. Shell Thickness (mm) Before and After DE Inclusion in Diet

TREATMENT	25 MAY		12 JUNE		
	NUMBER	MEAN (± S.E.)	NUMBER	MEAN (± S.E.)	F Ratio 3.8432
CONTROL	18	0.398 (± 0.0069)	8	0.380 (± 0.0076)	Prob>F 0.0161
D.E.	12	0.358 (± 0.0109)	8	0.394 (± 0.0140)	

The thickness of eggs of DE – fed bird was also significantly lower than the control birds before the start of DE feeding. Egg size was however not significantly affected by DE feeding (Table 4).

Table 4. Mean (±SE) Maximum Egg Diameter (cm) Before and After DE Feeding

TREATMENT	25 MAY		12 JUNE		
	NUMBER	MEAN (± S.E.)	NUMBER	MEAN (± S.E.)	F Ratio 1.0616
CONTROL	13	5.80 (± 0.087)	16	6.052 (± 0.069)	Prob>F 0.3914
D.E.	16	6.145 (± 0.158)	16	6.025 (± 0.1067)	

* Denotes significant differences in nutrient levels before and after the onset of DE feeding.

Significantly larger quantities of total sulfur and nitrates were found in manure collected after the onset of feeding. These nutrients may either be bound on the DE during passage or their absorption reduced by some other unidentified mechanism(s) in the gut.

Effect of a Single Topical Application of BARN FRESH™ on Adult Fly Population

Materials and Methods

The efficacy of a single topical application of BARN FRESH™ on a fly population was determined in two caged – layer barns of similar dimensions as those used for dietary trials. However manure in both barns was cleaned out on 17 May 01. The treatment barn housed 10 553 bird which were 29 week old at the start of monitoring on 19 July 01. The control barn housed 9 528 that were 38 weeks old at the start of trials. Between 19 July and 3 August, fly population trends in both barns were monitored using 100 cm^2 - index cards hang weekly at a height of 30 cm above the manure. To represent better the visible fly population, subsequently cards were placed on the floor along pathways in the barns. Six to seven cards were placed in each barn weekly and the data obtained was normalized for a 5 - hour exposure period. Mean comparisons were made using Student t – tests. On 14 August 01, 9 kg/10 m^2 of BARN FRESH™ were applied throughout the treatment barn ensuring that all the wet spots and larval patches were thoroughly covered. Monitoring was continued till the end of the trial on 29 August 01.

Results

Whereas the population index in the treatment barn increased to a larger extent one week after application, it dropped to a level not significantly different from the control barn a week later.

Table 7. Mean (±S.E.) Number of Spots per 100 cm^2 per 5 Hours Left on Speck Cards in Control and DE –Treated Barns

DATE	REPLICATES	CONTROL	DE
8 August	6	7.0550 (± 0.0998)	22.2233 (± 2.7042)
14 August	7	5.1786 (± 0.7968)	9.6429 (± 1.1471)
23 August	7	11.1429 (± 1.6392)	54.8571 (± 8.3336)
29 August	7	4.6129 (± 1.2049)	6.0986 (± 0.4315)

CONCLUDING REMARKS

Both dietary and topical applications of DE show considerable promise as components of an integrated fly and moisture management strategy. DE feeding is particularly desirable because of the low labor required to apply the material. Additional benefits of feeding DE may include improvements in shell thickness leading to reduced losses due to cracking. Further investigations are needed to substantiate the effect of dietary DE on fly populations and other production parameters.

Although BARN FRESH™ seems to possess sufficient absorbance for liquids such as the Pyrethrins concentrate, careful selection of test pesticides for impregnation may be necessary. For bait trials a stomach poison, rather than a contact pesticide may provide better results. For larvicidal action, a proven larvicide such as diflubenzuron may be more desirable. In the latter case it is necessary to determine the effect of moisture on degradation of the chemical active ingredient.