

# Northern Fowl Mite Population Development on Laying Hens Caged at Three Colony Sizes<sup>1</sup>

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**ABSTRACT** Beginning 5 weeks after being experimentally infested with known numbers of northern fowl mites, *Ornithonyssus sylviarum* (Canestrini and Fanzago), White Leghorn pullets caged alone supported a significantly higher mite population than did pullets housed two and three per cage. During the following 6 weeks, mite populations remained high on the birds caged singly whereas mite populations drastically declined on the birds housed two or three per cage. Eleven weeks after the experiment was initiated, all hens caged alone were infested with northern fowl mites, whereas 22% of the birds housed two per cage and 43% of the birds housed three per cage were free of mites. These data support the hypothesis that social stress in birds influences the development of northern fowl mites (more stress, higher resistance to mites).

(Key words: *Ornithonyssus sylviarum*, northern fowl mite, colony size, social stress, ectoparasites)

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## INTRODUCTION

The northern fowl mite, *Ornithonyssus sylviarum* (Canestrini and Fanzago), is considered the most important ectoparasite of domestic fowl in the United States (DeVaney, 1978). These blood-feeding mites complete their entire life cycle on the host, and under conditions of heavy infestation, they can cause economic loss to commercial poultry operations. Factors that may be important in the development of northern fowl mite populations include immune response of the host (DeVaney and Ziprin, 1980a,b), dietary requirements of selected strains (Matthysse *et al.*, 1974), inherited levels of plasma corticosterone in pullets (Hall and Gross, 1975), and sex hormones of hens (Hall *et al.*, 1978a).

Little is known concerning the effects of social stress in chickens on the development of northern fowl mites. Hall and Gross (1975) stated that high levels of social stress have been shown to increase the resistance of chickens to several diseases, but they found that social

stress alone had little effect on the mite population of cockerels. However, in other experiments (Hall *et al.*, 1979), roosters housed under conditions of low social stress were more susceptible to northern fowl mites than were roosters housed under high stress (i.e., housed in groups of 7).

In a field survey of two commercial caged-layer farms, Hall *et al.* (1978b) found that hens caged alone supported higher mean levels of northern fowl mites than did birds housed with cagemates. However, these surveys took place at a single point in time and did not consider conditions of exposure to mites, the length of time birds had been housed at a particular colony size, or prior records of the infestation levels of the hens that were examined. The purpose of our study was to examine the development of northern fowl mite populations among birds initially housed under differing colony sizes and infested with mites in an identical manner under experimental conditions.

## MATERIALS AND METHODS

White Leghorn pullets (Pfizer H and N pg 1 and pg 2 strains), 20 weeks old, were housed in a California-style narrow caged-layer house partitioned into sections of 40 cages each (10 per tier, 2 tiers per side). The cages were standard 10 × 12 × 16" commercial cages (.03 m<sup>3</sup>). The treatments consisted of placing the hens in colony sizes of one, two, or three birds

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per cage, randomly, arranged in two sections of the house. Each treatment was replicated 13 times with a total of 108 birds in the experiment. Feed and water were continuously available to the birds, and daily temperature inside the house ranged from 21 to 32 C in July and August and from 16 to 27 C in September.

On July 13, 1981, feathers infested with northern fowl mites were collected from a local commercial flock, and approximately 100 mites were placed on the vent region of each bird in the experiment. This was done by using a small brush to collect active mites as they moved from the infested feathers placed in a white pan. One week later the vent area of each hen was examined with the aid of a battery-powered headlamp to determine that all of the birds had an infestation. Mite counts were made at 1 week intervals thereafter. The mite population in the vent area was estimated using the following index: 0 = no mites observed, 1 = 1 to 10 mites; 2 = 10 to 50 mites; 3 = 50 to 100 mites, 4 = 100 to 500 mites, 5 = 500 to 1,000 mites, 6 = 1,000 to 10,000 mites, and 7 = >10,000 mites. The mite counts were recorded separately for each bird during the 11 weeks of the experiment. The data was analyzed using the general linear model and the Duncan's multiple range procedure to determine sig-

nificant differences (Barr *et al.*, 1979).

At the conclusion of the experiment, an attempt was made to relate the visual mite index to the actual numbers of mites present. The mites were extracted from 3 birds from each index level 2 through 6. All feathers from the vent region of each bird were removed, placed in a soap and water solution, and agitated by vigorous stirring. The mites were then collected by filtering the solution through filter paper in a Buchner funnel vacuum system. Due to the difficulty of filtering large numbers of mites, only two heavily infested feathers were pulled from each bird of index level 6 and the results extrapolated to the number of infested feathers observed in the vent area. The mites retained on the filter paper were counted using a stereo microscope and ocular grid. The total number was calculated from counts from 10 fields (each 1 cm<sup>2</sup>). The fields were located equidistant along two transects that intersected at right angles in the center of the filter paper disc (7 cm diameter). The 10 observations were totaled and the number of mites in each life stage multiplied by a correction factor to obtain the number of mites represented by the total area of the filter paper (38.5 cm<sup>2</sup>). Due to the large number of mites it was sometimes necessary to use more than one filter per sample. The following stages in the life cycle of the mites were counted: egg, larva, protonymph, deutonymph, and adult.

## RESULTS

There were no significant differences in the populations of northern fowl mites on the pullets housed one, two, or three per cage during the first 4 weeks after the initial infestation (Table 1, Fig. 1). The mite populations increased at all colony sizes during those 4 weeks. Beginning at 5 weeks after the initial infestation, the birds housed alone supported a significantly higher population of northern fowl mites than did birds housed two or three per cage. Further, mite populations remained high on the birds housed singly through the 11th week postinfestation, when the experiment was terminated, whereas mite populations drastically declined on the birds housed two or three per cage. Among the birds housed singly, 8 of the 18 birds had very high mite indices (7.0) during the 6 to 11th weeks of the experiment, 6 birds had a moderate index (5.0), and 4 had a low index (<4.0).

TABLE 1. Mean northern fowl mite indices at weeks after infesting for pullets initially infested with 100 mites per bird at 20 weeks age and housed at 1, 2, or 3 birds per cage.

Weeks after infesting	No. birds per cage		
	1	2	3
1	.67 <sup>a</sup>	.67 <sup>a</sup>	.57 <sup>a</sup>
2	1.78 <sup>a</sup>	1.70 <sup>a</sup>	1.69 <sup>a</sup>
3	2.06 <sup>a</sup>	1.70 <sup>a</sup>	2.19 <sup>a</sup>
4	2.83 <sup>a</sup>	2.36 <sup>a</sup>	2.30 <sup>a</sup>
5	3.61 <sup>a</sup>	2.67 <sup>b</sup>	2.34 <sup>b</sup>
6	3.50 <sup>a</sup>	2.87 <sup>ab</sup>	2.33 <sup>b</sup>
7	4.11 <sup>a</sup>	2.67 <sup>b</sup>	2.07 <sup>b</sup>
8	3.78 <sup>a</sup>	1.98 <sup>b</sup>	1.82 <sup>b</sup>
9	4.06 <sup>a</sup>	1.81 <sup>b</sup>	1.35 <sup>b</sup>
10	3.39 <sup>a</sup>	1.61 <sup>b</sup>	1.19 <sup>b</sup>
11	3.56 <sup>a</sup>	1.44 <sup>b</sup>	1.04 <sup>b</sup>

<sup>a,b</sup>Means within a row (week after infesting) followed by the same superscript letter are not significantly different ( $P < .05$ ) by Duncan's multiple range test (Barr *et al.*, 1979) (54 birds for the 3 per cage treatment, 36 birds for the 2 per cage treatment, 18 birds for the 1 per cage treatment).

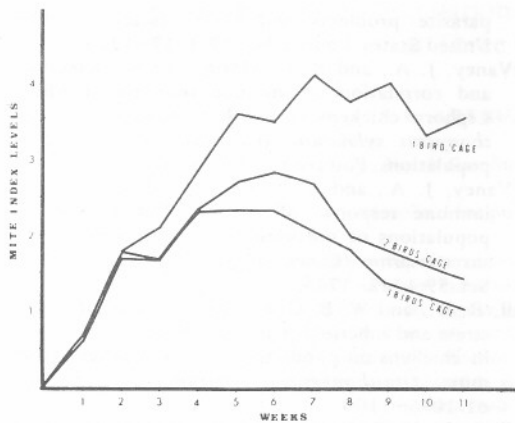


FIG. 1. Northern fowl mite population development on hens caged at three colony sizes.

Only 1 of the 54 birds housed three per cage and 2 of the 36 birds housed two per cage had a high mite population index (6.0) at any time during the experiment. At the end of the experiment, 22% of the birds housed two per cage and 43% of the birds housed three per cage were free of mites.

When correlated with the visual index levels, the laboratory method of analysis yielded a higher average estimate of the total mite population infesting a particular bird (Table 2). This indicated that the numbers obtained by using visual index levels were conservative values. The deutonymphs and adults were combined, because it was extremely difficult to determine the difference between those two stages.

## DISCUSSION

The results of this experiment show that birds housed alone are more likely to develop and maintain high populations of northern fowl mites than birds housed two or three per cage. This suggests that when northern fowl mites are introduced into commercial caged laying hen houses infestations are more likely to begin on birds that may be caged alone and is perhaps the means whereby mite infestations can originate in localized areas of a poultry house. The single birds, with their high potential for mite population increase, could then serve as a reservoir for dispersal. The single birds supported high populations of northern fowl mites for a longer time than the birds housed two or three per cage, and that would also be an important factor in dispersal. Our data confirm under controlled experimental conditions the observations made in commercial caged-layer houses by Hall *et al.* (1978b).

These data suggest that commercial caged-layer operations could reduce the severity of potential infestations by regulating colony size. When natural mortality occurs within a flock, the birds should be moved among the cages to avoid birds being housed alone for any length of time. If single birds are allowed to exist in a caged-layer house, these may be of value in monitoring for the presence of northern fowl mites as suggested by Hall *et al.* (1978b). With the increasing cost of treating an entire farm with acaricide, spot treatment of infested areas within poultry farms has been suggested as a means of reducing costs (Loomis *et al.*, 1970), and, if this is done, particular attention should

TABLE 2. Mean number of northern fowl mites of different life stages recovered by washing-filtration technique from vent area of birds rated at five different visual mite indices

Mite states	Mean <sup>a</sup> no. mites recovered for each mite index (see text)				
	2	3	4	5	6 <sup>b</sup>
Egg	592	507	857	1807	29037
Larvae	61	19	120	454	1908
Protonymph	310	238	495	837	14028
Deutonymph and adult	238	156	375	746	2634
Total, except eggs	609	413	990	1337	18570

<sup>a</sup>Mean based on extraction of all infested feathers (8 to 14) from the vent area of 3 replicates (birds) per mite index.

<sup>b</sup>Based on extraction of 2 feathers per bird and multiplication by 3 to give conservative estimate of total number per bird (vent area).

be given to treating single birds which are more likely to be infested.

One can only speculate on social stress as an explanation of the higher mite populations on birds caged in our experiment. Although social stress in birds shows an apparent influence on the development of northern fowl mites (more stress, higher resistance to mites), it is difficult to establish a cause and effect relationship. It appears that housing practices affect corticosteroid production, which is responsible for observed differences in mite populations (Hall *et al.*, 1978b). The addition of selected doses of steroids has been shown to increase the resistance of roosters to northern fowl mites (Hall *et al.*, 1979), but no information is available concerning similar tests using caged laying hens. Data concerning social stress and corticosteroid production in relation to northern fowl mite resistance are not sufficient to be evaluated in terms of the practical applications in poultry pest management programs. However, the data from commercial flocks and from our controlled experiment clearly indicate that the severity of northern fowl mite infestations on caged laying hens is related to colony size, and that should be considered in poultry pest management practices.

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