Silicas for control of the poultry red mite *Dermanyssus gallinae*

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***Abstract* – Control of the poultry red mite *Dermanyssus gallinae* is a challenge for organic as well as conventional egg producers. In organic agriculture, control should be attempted by mechanically acting substances (e.g. oils or diatomaceous earth), before acaricides are applied. Diatomaceous earth (DE) without acaricides was at least as effective as DE supplemented with pyrethrum or essential oils and a liquid formulation of silica *in vitro*. In on farm experiments, DE was effective during a limited period only, whereas the liquid formulation had a very good residual effect over several weeks.[1]**

Introduction

The poultry red mite *Dermanyssus gallinae* is regarded as the most important external parasite of laying hens in organic as well as in conventional egg production in Europe (Maurer *et al*., 1993; Höglund *et al*., 1995). The haematophagous mite is a nocturnal feeder and spends the day in the surroundings of the hens. At high population densities poultry red mites can cause severe anaemia; already low mite populations irritate the hens to an extent that they refuse to go into the henhouse or rest on the perches. Controlling the mite during flocks is difficult. In Switzerland, a three-stage system for the control of this mite on organic farms is currently applied by organic farmers (I: cleaning and disinfection of the empty house, II: use of mechanically acting substances, III: specific use of acaricides). Within the project QLIF, the effectiveness of measures belonging to all three stages is evaluated. This paper focuses on the use of silicas for the control of chicken mites (stage II). Products based on silica are often used as mechanically acting agents against *D. gallinae*; these products are damaging the protective layer of the mite's epicuticle and thus drying them out. Drawbacks of diatomaceous earth are the formation of dust at treatment and the decrease of efficacy due to humidity. To overcome those drawbacks, products with added acaricides and other formulations of silica have been developed.

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Materials and Methods

In vitro assay

Dermanyssus gallinae from a naturally infested poultry house were used for the tests within 1 day after collection. Three diatomaceous earths and a liquid formulation of silica were tested *in vitro* (Table 1).

Five adult female mites were transferred into plastic vials containing the powders or a filter disk treated with the liquid test product. Empty vials served as a control. Survival of the mites was observed after 4, 24, and 168 hours. Each product was tested in two series with 5 replicates/series. The mites were kept at 27°C during the experiment.

For statistical comparison of the survival of the mites, the integral of the survival curves was estimated for each vial (trapezoidal integration; "area under the disease progress curve" AUDPC, Campbell & Madden, 1990).

Table 1. Products tested in vitro

Label	Description
D1	Diatomaceous earth
D2	Diatomaceous earth with essential oils
D3	Diatomaceous earth with Pyrethrum
L1	Silica, liquid formulation

On farm experiments

Experiment 1 was carried out on an organic commercial layer farm with known problems with chicken mites. Severe mite problems occurred 9 months after establishment of the flock. The aviary system for 2000 layers (Harmony Type C) was divided into 4 compartments for 500 birds each. Per compartment, 4 mite traps consisting of a u-shaped aluminium-profile containing a strip of fabric in a zigzag fold (Maurer *et al*., 1993) were mounted under the perches for monitoring the mite population. The strips were left in the profiles for 3 to 4 days, removed and the containing mites were dried and weighed. Diatomaceous earth (D1 in Table 1) was either dusted (30g/m2 floor surface) or the same amount applied by means of mite traps filled with the dust and mounted under the perches. Compartment A remained untreated, compartment B was equipped with the traps filled with diatomaceous earth, and compartments C and D were dusted. The mites were sampled during 4 days prior to treatment and during the next 3, 4, 3, and 4 days after treatment.

In *experiment 2*, identical poultry houses for 25 birds each were used for the treatment with a liquid formulated product (L1 in Table 1). House A was sprayed with the test product and house C was left untreated as a control. Two traps were mounted per house; the strips of fabric were exchanged weekly and the contained mites were weighed. The hens stayed in the treated houses for 3 weeks and were then replaced by a new flock.

Results and Discussion

The results of the *in vitro* tests are presented in Table 2.

Table 2. AUDPC of products tested *in vitro*.

Label	Description	AUDPC
D1	Diatomaceous earth (DE)	1564
D2	DE with essential oils	9491
D3	DE with Pyrethrum	1892
L1	Silica, liquid formulation	7796
C	Control	16368

Diatomaceous earth with or without additional pyrethrum (D1, D3) caused rapid mortality of the mites, reflected by low AUDPC; the other products were significantly less effective *in vitro* ($P<0.001$), but still more effective than the control ($P<0.001$). The difference between D2 and the other products based on DE is probably due to the use of different qualities of DE. This indicates that the quality of the raw material is the dominant factor for the effectiveness of DE products.

Figure 1 shows the abundance of *D. gallinae* in the traps during on farm experiment 1. The dynamics of the mites in experiment 2 is presented in Fig. 2.
In both experiments, treatments with silicas reduced the numbers of chicken mites caught in traps. This effect was of relatively short duration when diatomaceous earth was applied, irrespective of the mode of application. Practical experience has shown that good control is achieved with repeated treatments. The liquid formulation of the product applied in experiment 2 had a longer residual effect, which lasted over the replacement of the flock (data not shown). The different results obtained on farm and *in vitro* are investigated in further studies.

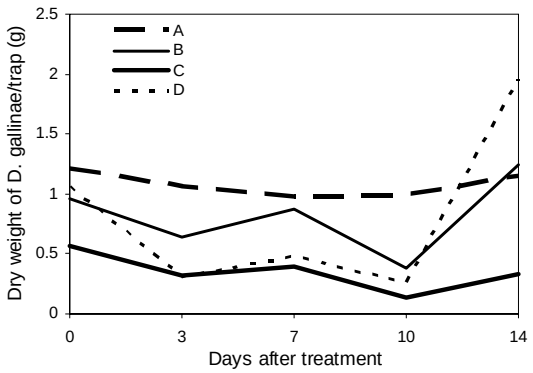

Figure 1: Abundance of D. gallinae caught in traps in experiment 1. Solid lines: diatomaceous earth dusted; dotted line: diatomaceous earth in traps; interrupted line: untreated control. Treatment on day 0.

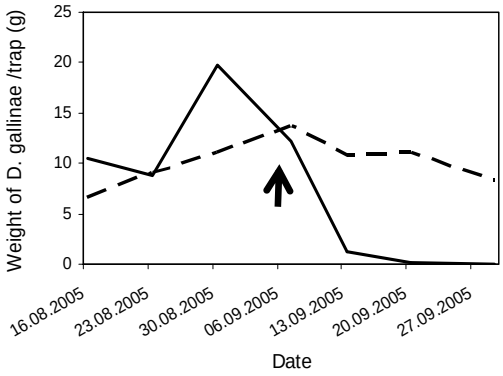

Figure 2: Abundance of D. gallinae caught in traps in experiment 2. Solid line: liquid formulation of silica; dotted line: untreated control. Arrow: treatment.

The results of the *in vitro* tests and of on farm experiments indicate that good physical effects of silicas against *D. gallinae* should be enhanced by the selection of high quality raw materials and by means of formulation rather than by addition of acaricides.

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