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Prevalence and key figures for the poultry red mite *Dermanyssus gallinae* infections in poultry farm systems

Olivier Sparagano · Aleksandar Pavlićević · Takako Murano · Antonio Camarda · Hamid Sahibi · Ole Kilpinen · Monique Mul · Rick van Emous · Sophie le Bouquin · Kristian Hoel · Maria Assunta Cafiero

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Abstract Recent surveys and sample collection have confirmed the endemicity of *Dermanyssus gallinae* in poultry farming worldwide. The reduction in number and efficacy of many acaricide products has accentuated the prevalence rates of this poultry ectoparasite observed more often in non intensive systems such as free-range, barns or backyards and more often in laying hens than in broiler birds. The lack of knowledge from producers and the utilisation of inadequate, ineffective or illegal chemicals in many countries have been responsible for the increase in infestation rates due to the spread of acaricide resistance. The costs for control methods and treatment are showing the tremendous economic impact of this ectoparasite on poultry meat and egg industries. This paper reviews the prevalence

O. Sparagano
School of Agriculture, Food and Rural Development, Newcastle University, Agriculture Building, Newcastle Upon Tyne NE1 7RU, UK

A. Pavlićević
AVES Inc, Palic, Serbia

T. Murano
Chiba Prefectural Livestock Research Center, He 16-1 Yachimata, Yachimata, Chiba 289-1113, Japan

A. Camarda
Dipartimento di Sanità Pubblica e Zootecnia, Facoltà di Medicina Veterinaria, Università degli Studi di Bari, 70100 Valenzano, Italy

H. Sahibi
Département de Pathologie et de Santé Publique Vétérinaires, Unité de Parasitologie et Maladies Parasitaires, Institut Agronomique et Vétérinaire Hassan II, BP 6202, Rabat-Institut, Rabat, Morocco

O. Kilpinen
Institute of Integrated Pest Management, Danish Pest Infestation Laboratory, University of Aarhus, Skovbrynet 14, 2800 Kgs. Lyngby, Denmark

M. Mul · R. van Emous
Animal Sciences Group of Wageningen UR, P.O. Box 65, 8200 AB Lelystad, The Netherlands

rates of this poultry pest in different countries and for different farming systems and the production parameters which could be linked to this pest proliferation.

Keywords *Dermanyssus gallinae* · Prevalence · Infestation rates · Control costs · Poultry

Introduction

Dermanyssus gallinae (De Geer, 1778) also known as the poultry red mite (PRM) or the poultry mite is an increasing epidemiological and economical problem for the poultry industry worldwide. This ectoparasite is a blood feeder and is responsible for egg downgrading and spotting, anaemia in birds and more reports suggest it could have a vector role for several human and animal diseases. It is the most important ectoparasite affecting laying hens (Chauve 1998).

The current European legislation which will ban by 2012 traditional cages for poultry birds (European Council Directive 1999/74/EC) and the removal of acaricide products from national markets due to the increase in acaricide resistance or welfare concerns will have a tremendous impact on the proliferation of such pest which has shown in this paper in endemic in many countries and is becoming the most serious deleterious ectoparasite in poultry farming systems worldwide. New control methods highlighted in other papers within this special *Dermanyssus* issue in Experimental and Applied Acarology, show the need to urgently tackle such parasites to reduce economical losses, improve welfare, and control zoonotic risks for farming workers.

Poultry data

Poultry production is an important and increasing meat/egg market with millions of birds grown in participating countries as shown on Table 1 in parallel of the staggering 8.56 billion birds raised annually in the USA.

Caged animals are making the most of the laying hen production systems up to 100% in Japan for instance with free range and barns systems making the rest, in some countries, while the organic production system (although increasing in some developed countries) represent only a few percents of the global market.

The introduction of "enriched cages" in some countries could become a major production possibility if producers cannot convert their traditional cage systems into less extensive systems. However, the use of enriched cages with nesting boxes could help the mites to better survive, hide, and therefore infest more poultry in this new system supposedly improving birds' welfare. By improving animal welfare enriched cages could unfortunately also optimise survival conditions for the poultry red mites (Chirico and Tausan 2002).

S. le Bouquin
Unité EBEAC, AFSSA, BP 53, 22 440 Ploufragan, France

K. Hoel
Animalia, P.O. Box 396, Økern, 0513 Oslo, Norway

M. A. Cafiero (✉)
Istituto Zooprofilattico Sperimentale della Puglia e della Basilicata, Via Manfredonia, 20,
71100 Foggia, Italy
e-mail: ma.cafiero@izsfg.it

Table 1 Key data for poultry production and *Dermanyssus gallinae* prevalence

Country	Annual poultry production in million birds (average flock)	% in traditional cages	% in enriched cages	% in barns	% in free-range	% in organic systems	% in backyards	Other systems	*Dermanyssus* prevalence[a] (%)	Estimated annual cost of *Dermanyssus*
Denmark	2.7 (11,700)	56	<1	23	6	15	Unknown	Unknown	C: 32 B: 50 FR: 68 Organic: 36	Unknown
France	46.5 for laying hens and 111 for broilers (cages: 39,800; other systems: 5,700)	76.5	4.6	3.4	8.6	3.0	Unknown	8% "Red Label"	C: 72 B: 50 FR: 56 Organic: 80	Cages: 4.33 €/100 birds; alternative systems 3.83 €/100 birds)
Italy	486 including 435 for broilers and 51 for layers (15,000–20,000)	96.4	Unknown	2.4	0.5	0.7	Unknown		C: 74.1	Unknown
Japan	860 (unknown)	Circa 100	0	<1.0	0	<1.0	<1.0		C Layers: 85.2 C for broilers: 0.6	66.85 million €
Montenegro	0.43 (2,500–25,000)	87	4.0	3.75	1.00	Unknown	3.75	None	C layers 30–80	Unknown
Morocco	294 (unknown)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	BY: 90 C broilers: 20 C layers: 55	Unknown
Norway	3.6 (1,900)	54.0	26.0	18.0	0	2.0	0	None	C layers: 23	Unknown
Serbia	80.0 (unknown)	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	C layers: 90	Unknown
The Netherlands	30.12 (26,600)	46.0	2.0	40	12.0	2.0	None	None	C: 82 B: 83 Organic: 78	11.0 million €
UK	860 (10,380)	60.0	Unknown	4.0	30.0	6.0	Unknown	Unknown	C: 7.5–87.5 B: 32.5 FR: 60.0	3 million €

[a] *C* cages, *B* barns, *FR* free-range, *BY* backyard

Red mite prevalence

Infestation rates can reach 80–90% of poultry birds as observed in the United Kingdom (UK), Italy, Serbia, Morocco, Japan, Montenegro, and The Netherlands (Table 1). Less intensive farming systems such as barns, free range and organic farming are often showing higher prevalence rates due to the greater potential for *D. gallinae* to hide in cracks and crevices and avoid chemical control methods. For instance, Höglund et al. (1995) observed only 6% infestations in cage systems but 33% in alternative systems and 67% of backyard flocks being infested. Similar figures were observed in UK with 7.5, 32.5 and 60% for the above three poultry systems, respectively (Anon 2003). However, as shown in Table 1 there is no prevalence trends between poultry systems as different countries show different prevalence rates. In The Netherlands, poultry husbandry advisers estimate a prevalence of 95%. Considering that many countries will ban cages there is therefore a risk that *D. gallinae* prevalence will increase with higher economical losses for the farming industry if such pest is not under control rapidly.

Associated costs

The cost of *D. gallinae* is difficult to evaluate on a global scale but some colleagues have been able to calculate costs at national levels such as 4.33 €/100 birds and 3.83 €/100 birds for cage and alternative systems in France, respectively (Lubac et al. 2003). In The Netherlands, Dutch poultry farmers estimated the costs for preventive and control measures to be €0.14 per hen per round and de damage due to RPM because of higher feed intake, higher mortality, and lower egg quality were estimated as €0.29 per hen per round (Emous et al. 2005) or as shown on Table 1 representing millions of euros/dollars in production and animal losses, treatment, veterinary bills, and lost working days.

Human costs are difficult to establish but cases of dermatitis related to *D. gallinae* are now more and more obvious while workers in some countries had to be paid 3 times more in recent years to work with *D. gallinae* infested birds (Sahibi et al. 2008). In Egypt, a report showed similar attacks on farm workers from *Ornithonyssus* mites (Mazyad and Abel El-Kadi 2005) while it was with *D. gallinae* in Israeli poultry workers (Rosen et al. 2002). As *D. gallinae* is also feeding on synantropic birds, including pigeons and sparrows, more cases have recently been published on human attacks due to bird nests found in close proximity to private households (Rosen et al. 2002; Cafiero et al. 2008), hospitals (Sexton and Barton 1975; Auger et al. 1979; Regan et al. 1987; Bellanger et al. 2008) or offices (Cafiero et al. 2007). Furthermore, the red mite can feed also on the wild birds (Kristofik et al. 1996) or on other animals (Ramsay et al. 1975; DeClercq and Nachtegaele 1993; Mignon and Losson 2008).

Prevalence seems to be dependent of several parameters

The research done for this paper showed that in Southern Italy (Apulia region) farm sizes had an important impact on prevalence with small farms (1,000–5,000 birds) showing a prevalence of 92.3% while bigger farms (5,000–20,000 birds) showed a prevalence of 55.9% only (in laying birds). These results are higher than the 20% infestation rate previously observed in the Italian Abruzzo region (central region of Italy) in traditional (free-range) poultry farms (Paoletti et al. 2006).

Change of flocks and repopulation can have a tremendous impact on *D. gallinae* as observed in Montenegro where the prevalence in layers in cages was 30% at the beginning of 2007 but dramatically rose to 80% after flocks were repopulated.

Fig. 1 European farm heavily infested with *Dermanyssus gallinae*

In France, reports show an endemic situation with almost all part of the country showing infestations (Beugnet et al. 1997; Chauve 1998) with a higher prevalence during the winter (Lubac et al. 2003) whereas in Denmark worst infestation cases are observed in the late summer (personal communication, Kilpinen, Lyngby, Denmark) and also in Italy (personal communication, Camarda, University of Bari, Italy).

In UK, several authors have also reported high prevalence rates (Guy et al. 2004; Fiddes et al. 2005).

Bad hygiene practices will have dramatic impacts on poultry mite population as shown on Fig. 1. The accumulation of dust increases the ways for the mites to hide and anaemic unhealthy birds are more susceptible then to further attacks. Temperature and humidity also could play an important role (Nordenfors et al. 1999).

The current study in Italy observed that poultry breeds do not seem to influence the prevalence of this pest. Farms using the Warren breed and the Hy-line hybrid birds had a prevalence of infestation of 76.3 and 70.0%, respectively. Out of the 58 farms in the Italian study 65.5 and 34.5% were using the Warren and Hy-line breeds, respectively.

Discussion and conclusions

The results presented in Table 1 are comparable to those already published in other countries such as Kenya (Mungube et al. 2008) with 60% of *D. gallinae* infection in backyard chickens, Romania (Magdas et al. 2006) with a prevalence ranging from 57.5 to 72.5% depending of the locality, 100% in Poland (Cencek 2003), and 67% in Sweden (Höglund et al. 1995).

The diversity in terms of control methods and product used in some countries have shown the impact of the resistance capacity of the *Dermanyssus* populations (Marangi et al. 2008a) suggesting that an integrated method using more than one control methods could become the norm in many countries with acaricide restriction/resistance (Fiddes et al. 2005) to avoid recontamination of farm infrastructures knowing that mites can survive for a long time (Pavlićević et al. 2007) Such variation in acaricide resistance between countries

could also explain the phylogenetic diversity between *D. gallinae* populations (Marangi et al. 2008b).

Temperature and season would also have an impact on poultry mite reports from farmers (Nordenfors et al. 1999). The fact that small farms have a higher level of infestation in Italy could be explained by the fact that on small premises farmers tend not to use air conditioning and do not have a break between production cycles allowing mites to feed on birds almost constantly.

Considering that this poultry pest can also attack other avian species (De Lope and Moller 1993; Gicik 1999; Romaniuk and Owczarzak-Podziemska 2002) could also boost prevalence rates in open poultry systems in which wild birds can enter and carry red mites. Even dogs, gerbils, rabbits, and other rodents have been observed carrying the poultry red mite allowing further import on farm infrastructures (Soulsby 1982; Bakr et al. 1995; Lucky et al. 2001).

It is also observed by colleagues in Serbia that another way to contaminate farms with the PRM is when farmers purchase used equipment. This situation will increase with the EU ban on conventional cages which could force many farmers who financially cannot buy new equipment to try reducing their costs by using infested second-hand enriched cages (personal communication, Pavlićević, Serbia).

Furthermore, an increase in the prevalence rates could also have an epidemiological impact on human and veterinarian diseases as the risks of *D. gallinae* transmitting more pathogens would increase as well (Valiente Moro et al. 2005, 2007, 2008).

The role of the national Veterinary Services (and veterinarians) is of paramount importance to assist farmers using the correct control products and dosing to avoid building even further acaricide resistance (see article from Mul and Koenraadt 2008). Knowledge transfer between veterinarians, scientists and the farming communities would also avoid misusing control methods which on a long term will bring more problems to the poultry industry.

It is also important to mention that due to the new EU Directive banning cages in 2012 some farmers are buying used equipment to reduce the costs or adapting to the new European legislation; doing so it increase the exchange of infested equipment passed between farms and contaminating new premises. It is therefore crucial for the poultry industry and the help of governments to constantly monitor mite population to put in place surveillance zones and movement restrictions when outbreaks of *D. gallinae* are observed on farms. In some European countries, such as in Italy, it is not compulsory to notify the Ministry of Agriculture when red poultry mite proliferations are observed on farms and it can lead to different attitudes from veterinarians. For this we would suggest an integrated and concerted European approach to report such infestations, which can spread between farms if good hygiene practices are not observed by the farm workers .

This paper has shown the importance and urgency linked to *D. gallinae* infestations and it is also important for governing bodies to participate in the control/eradication of such pest by funding networking and research collaborative work between industrials, researchers, and farmers.

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