

Elimination of *Sarcoptes scabiei* in Pig Herds by Single or Double Administrations of an Avermectin

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Jacobsen M, Bornstein S, Palmér E, Wallgren P: Elimination of *Sarcoptes scabiei* in pig herds by single or double administrations of an avermectin. Acta vet. scand. 2000, 41, 227-235. – Attempts to eliminate *Sarcoptes scabiei* var. *suis* were made in 2 piglet producing herds by intramuscular injections with doramectin (Dectomax™, Pfizer inc., New York, USA). No hygienic measures of the environments were undertaken. In herd A, all animals were treated twice at a 14-day interval. Theoretically it should be possible to eliminate the mite with a single injection and therefore the animals in herd B were treated only once. The results were measured by attempts to demonstrate *S. scabiei* by skin scrapings, by recording skin lesions, by establishing rubbing indexes, and by measuring serum antibodies to *S. scabiei*. All adult animals greater than 8 months of age and 15 weaned piglets 8-16 weeks of age per herd were investigated prior to treatments and every fourth month for a total of 20 months following administration of the treatments. Live *S. scabiei* were demonstrated prior to treatments in both herds, but no further. Skin lesion scores, rubbing indexes and serum antibody levels remained low throughout the study. It is possible to eliminate *S. scabiei* from a herd with one single injection of doramectin. Precautions must be taken to ensure that all animals get a correct dose and that the drug is properly administered.

macrocyclic lactone; doramectin; ELISA.

Introduction

Infections with the mite *Sarcoptes scabiei* var. *suis* cause a common disease known as sarcoptic mange (Sheahan 1974, Cargill & Dobson 1977, Hollanders & Vercruyse 1990). The disease usually begins with an acute hypersensitivity reaction (Sheahan 1974, Cargill & Dobson 1977, Bornstein & Zakrisson 1993) with clinical signs such as pruritus and urticarial wheals. In addition, the pigs often exhibit light encrustations in the ears. These encrustations either persist or may aggravate as the infection develops into chronic disease with skin lesions, particularly on the inner surface of the ear and distal parts of the body, but usually with a less pronounced pruritus (Sheahan 1974, Cargill &

Dobson 1979a, Bornstein & Zakrisson 1993). Affected pigs may be severely stressed and show reduced performance (Alva-Valdes et al. 1986, Cargill & Dobson 1979b, Arends et al. 1990).

Different methods have been used to diagnose the disease, of which the most definite is demonstration of the parasite. This method is, however, stated to have a low sensitivity (Yeoman 1983, Kamarage 1993, Bornstein & Wallgren 1997) and is therefore not considered to be a useful tool in herds with low to moderate clinical signs of mange, i.e. herds suffering from subclinical infections. Other diagnostic tools include counting of rubbing episodes over a set

period of time, out of which a rubbing index can be calculated (Cargill & Dobson 1979b, Hollanders et al. 1995, Davies 1995), measurement of skin lesions similar to those caused by mange and the calculation of a mean lesion score (Cargill & Dobson 1979b, Pointon et al. 1987, Davies 1995), and demonstration of serum antibodies to *S. scabiei* by ELISA (Nöckler et al. 1992, Bornstein & Zakrisson 1993). The latter method is the most specific of these diagnostic tools (Bornstein & Wallgren 1997).

In order to reduce animal suffering and increase performance, attempts to eliminate mange at a herd level have been made during the last decades (Henriksen & Ebbesen 1987, Hogg 1989, Lambers 1994). Generally these programmes have included repeated treatments of animals with effective acaricides in combination with a simultaneous emptying, cleaning and disinfection of the environment. As recently reported (Bornstein et al. 1994, Jacobson et al. 1999), it appears possible to perform such elimination programmes without any simultaneous environmental precautions. Thus the effectuation of such elimination programmes may be considerably facilitated and thereby more attractive to the farmers.

Different acaricides have been used in elimination programmes (Hogg 1989, Madsen 1990) but the avermectins have dominated, probably due to their systemic and prolonged effects (Courtney et al. 1983, Hogg 1984, Henriksen & Ebbesen 1987). The only previously available macrocyclic lactone has been ivermectin (Ivomec[®], Merial, Lyon, France), but recently new products, such as doramectin (Dectomax[®], Pfizer, New York, USA) and moxidectin (Cydectin[®], Fort Dodge Animal Health, Kansas City, Missouri, USA) have entered the market. Doramectin is an avermectin registered for use in pigs administered by intramuscular injection. In pigs the avermectins are considered to have a

clinical duration of 9 to 18 days, during which no reinfections will occur (Arends et al. 1999). The sarcoptic mite is only able to survive outside the host for a short period (Mikhalochkina 1975). Taking the life cycle of the parasite (Soulsby 1982, Hogg 1989) into account, a single avermectin treatment of the animals appears to be sufficient to eliminate mange on herd level (Hogg 1984, Cargill et al. 1996). However, in this context it is important to consider that incorrect medication of one single animal probably will lead to failure of the elimination attempt. The aim of the present study was to compare the efficacy of using one or 2 treatments with an avermectin at attempts to eliminate *S. scabiei* on herd basis.

Materials and methods

Herds

The study was conducted in 2 conventional piglet-producing herds, designated A and B. Herd A comprised 35-41 sows during the study. Herd B initially comprised 21 sows and increased to 51 sows at the end of the trial (Table 1). Replacement gilts and boars were bought from nucleus herds. They were kept in quarantine for 4 weeks before entering the herds. In addition, herd B also kept a few fattening pigs on site at the beginning of the trial.

Both herds comprised one farrowing unit, one unit for dry sows on deep straw bedding, and one unit for weaned piglets at the age of 5-16 weeks. They performed continuous farrowing production and sold piglets at approximately 25-kg body weight.

Low to moderate clinical signs of mange were present in both herds and *S. scabiei* was demonstrated by deep skin scrapings and by antibodies to *S. scabiei*, prior to treatments.

Experimental design and treatment strategy

The animals were restrained and doramectin was injected intramuscularly in the neck behind

Table 1. The presence of *Sarcoptes scabiei* in skin scrapings from weaners and adults before and after initiating intramuscular administrations of doramectin. Doramectin was administered twice with an interval of 14 days in herd A, but only once in herd B. At each occasion, all adult animals and 15 weaners in each herd were sampled.

Time after initiating treatment (months)	Herd A		Herd B	
	Weaners	Adults	Weaners	Adults
0 (before)	5/15	1/35	3/15	0/21 ²
1	0/15	0/35	3/15 ¹	0/22
4	0/15	0/38	0/15	0/20
8	0/15	0/39	0/15	0/46
12	0/15	0/34	0/15	0/46
16	0/15	0/40	0/15	0/57
20	0/15	0/41	0/15	0/51

¹ Dead mites. ² *S. scabiei* was demonstrated in 6 out of 15 investigated fatteners present in herd B before effectuating the programme.

the ear, at a dosage of 300 µg per kg body weight. All pigs above 5 days of age were weighed prior to treatment and their individual treatment dose was calculated. Newborn piglets were treated as soon as they reached the age of 5 days.

In herd A, all pigs in the herd were injected twice at an interval of 14 days. In herd B, the animals received only one injection. No environmental acaricide treatment was undertaken. All replacement animals purchased after the initiation of the programme were kept for 28 days in isolation before entering the herds. During the quarantine, replacement stock for both farms were injected twice with doramectin, the first treatment immediately after arrival and the second treatment 2 weeks later.

Monitoring

The results of the studies were monitored by demonstration of live or dead *S. scabiei*, by assessing skin lesions associated with mange, by the calculation of a rubbing index and by demonstrations of serum antibodies with an ELISA (Bornstein & Wallgren 1997). At each sampling occasion all adults and 15 weaners were sampled. Monitorings were conducted prior to

treatment, at the day of the first treatment, and every fourth month. Monitoring continued for a period of 20 months onwards. An additional visit, during which skin lesions and rubbing indexes were recorded and skin scrapings were sampled, was made one month after the initial treatment. Blood samples were also collected from purchased replacement animals during their stay in the quarantine.

Demonstration of *S. scabiei*

Skin scrapings were taken with sharp plastic spoons from deep inside the pinnae of the ear of the pigs. The samples were mixed with glycerine and stored under light for 24-48 h. Live mites were searched for under microscope. If no mites were found, the samples were mixed with 10% potassiumhydroxide (KOH) solution, centrifuged and examined for the presence of *S. scabiei*.

Skin lesions and rubbing index

Skin lesions similar to those caused by *S. scabiei* were defined on a scale from 0 to 3 (0= no lesions, 1= <1 cm in diameter, 2= 1-2,5 cm in diameter, 3= >2,5 cm in diameter). These lesions included plaques, maculas, crusts and/or

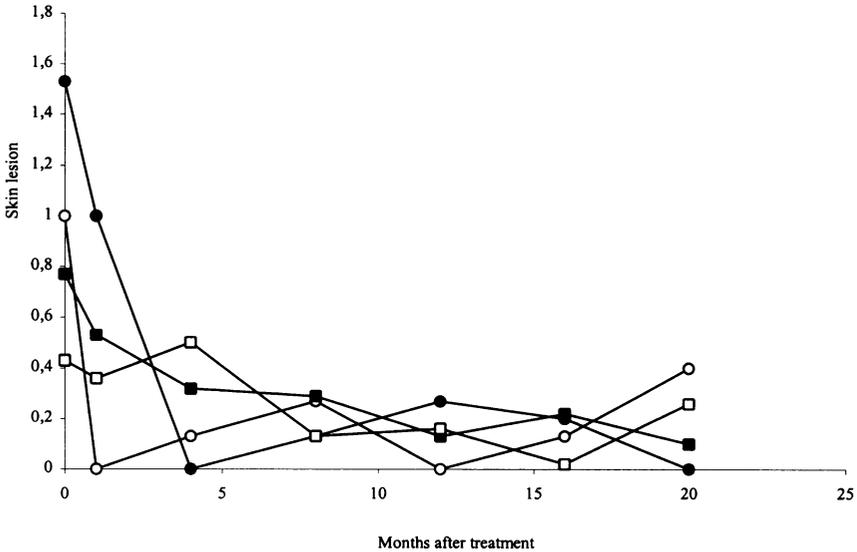


Figure 1. Skin lesions recorded among sows (squares) and offspring (circles) in herd A (filled symbols) and herd B (open symbols) before and after implementation of treatment programs aimed to eliminate *Sarcoptes scabiei*. The standard deviations varied from 0.0 to 0.89.

hyperkeratosis. Rubbing indexes were calculated by observing and counting every rubbing episode of each adult animal and each group of weaners, respectively, for 15 min. The observations were made in the middle of the day, separate from feeding. To achieve the rubbing index, the number of rubbings was divided by the number of individuals in the group.

Antibodies to *S. scabiei*

Blood samples without additives were collected by jugular vein punctures and the sera were stored at -20°C until analysed. Antibodies to *S. scabiei* were detected in serum diluted 1/200 in PBS-Tween using an indirect ELISA previously described (Bornstein & Zakrisson 1993, Bornstein & Wallgren 1997). The ELISA was read at 492 nm and absorbance values above 0.175 and 0.08 were regarded as positive reactions in adult animals and weaners, respectively.

Results

Results obtained prior to treatments

The pigs exhibited low to moderate clinical signs of sarcoptic mange prior to treatments. Among weaners, the mean skin lesion score was 1.53 ± 0.52 in herd A, and 1.00 ± 0.54 in herd B. Among the adults, the mean lesion score was 0.77 ± 0.92 in herd A, and 0.43 ± 0.06 in herd B (Fig. 1).

The average rubbing index values recorded among weaners were 0.39 in herd A and 0.20 in herd B. Among adults, the corresponding figures were 0.74 and 0.00, respectively (Fig. 2).

Live *S. scabiei* mites were demonstrated in one of the adult animals by deep skin scrapings in herd A, and in 5 of the weaners (Table 1). In herd B, live sarcoptic mites were found in 3 weaners and in 6 slaughter pigs.

The mean absorbance values of serum antibodies to *S. scabiei* were 0.16 ± 0.12 and $0.11 \pm$

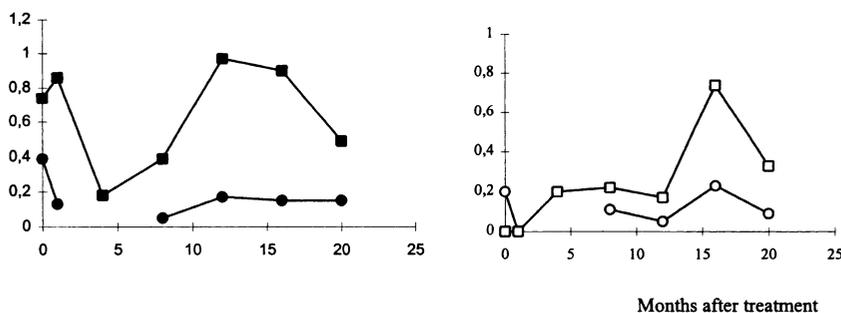


Figure 2. Rubbing indexes in adults (squares) and weaners (circles) in herd A (filled symbols) and B (open symbols), respectively. A marked seasonal variation was seen in the rubbing indexes among the adults. They were housed in deep straw bedded non-insulated barns. During the cold winter seasons they preferably buried themselves in the bed in-between feedings and thus showed an overall reduced activity.

0.08 among weaners in herd A and B, respectively. The corresponding values obtained in sera collected from adults were 0.17 ± 0.06 and 0.18 ± 0.08 , respectively (Fig. 3).

Results obtained following treatments

No signs of clinical mange were observed in either herd A or herd B following the doramectin treatments. Nor was any adverse drug reaction observed. Skin lesion scores declined throughout the study. At the final inspection, 20 months after the first of 2 treatments in herd A, the skin lesions had declined to nil among the weaners and to 0.05 ± 0.23 among the adult animals in herd A. In herd B, at 20 months after a single treatment, the skin lesion score had declined to 0.40 ± 0.63 among the weaners, and to 0.25 ± 0.60 among the adults (Fig. 1).

The rubbing indexes calculated for weaners remained low throughout the study (Fig. 2). A low incidence of rubbing episodes (less than 1 per animal during 15 min) was also recorded among the adults. However, the rubbing incidence among adults fluctuated over time in both herds. As shown in fig. 2, the sows rubbed themselves more often during the summer.

In total 552 skin scrapings from adults and 225

samples from weaners at the age of 8-16 weeks, were analysed for the presence of mites. No live mange mites were found after administering the treatments. Dead *S. scabiei* mites were found by KOH treatment in 3 weaned piglets one month after the treatment in herd B, but not later (Table 1).

The mean absorbance values of antibodies to *S. scabiei* measured in serum collected from weaners had decreased to 0.05 ± 0.02 in both herds 4 months after the treatments and remained at that level throughout the study (Fig. 3). Similarly, the mean antibody levels obtained in serum from sows had ranged between 0.11 ± 0.03 and 0.13 ± 0.04 from 8 months after treatment and onwards in herd A. At the last sampling occasion, 20 month after treatment, the serum antibody levels had declined to 0.10 ± 0.02 . In contrast the mean absorbance level of antibodies to *S. scabiei* in herd B actually increased from month 4 to month 8, during which period the number of sows increased from 20 to 46 by the purchase of new gilts (Table 1). Thereafter the level of antibodies gradually decreased to a level of 0.13 ± 0.04 at the last sampling occasion.

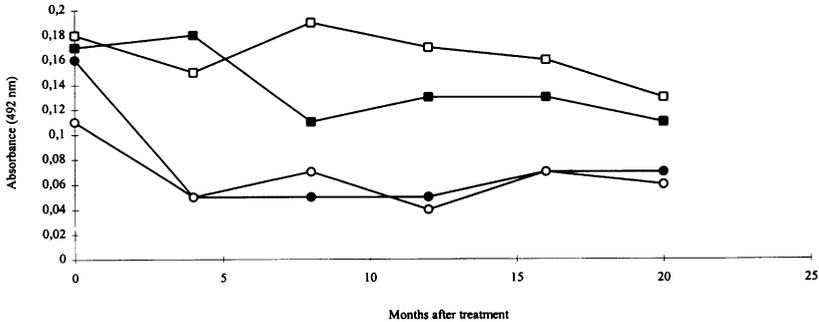


Figure 3. Mean absorbance values of antibodies to *Sarcoptes scabiei* in serum collected from weaners (circles) and from adults (squares) before and after the treatment with doramectin. The filled symbols represent herd A and the open symbols represent herd B (standard deviations in both herds varied from 0.01 to 0.07 through the study). The increased absorbance level among sows in herd B 8 months after the treatment, reflects the increase from 20 to 46 sows made by merchandise of seropositive sows.

Discussion

Due to the efficacy of modern acaricidal drugs it is possible to eliminate sarcoptic mange without undertaking any specific environmental acaricide hygienic measures (Bornstein et al. 1994, Jacobson et al. 1999). The life cycle of *S. scabiei* is stated to last for 10-15 days (Soulsby 1982), and the parasite is unable to survive away from its host for more than 12 days under natural conditions (Mikhalochkina 1975). The therapeutic effect of modern acaricidal drugs may persist for a longer period, therefore it might be possible to further simplify elimination attempts by employing only one single acaricidal treatment (Hogg 1984, Cargill et al. 1996, Arends et al. 1999).

The results obtained on one farm in this study agreed with this hypothesis in all substantial parts. No signs of mange infection were present following the elimination attempts, either by single or double intramuscular injections with doramectin. However, because no effect should be expected from drugs if deposited in fat tissue (Schultz et al. 1988), an increased risk for failure due to improper medical administration should be taken into account if treating the ani-

mals only once. That risk will decrease if the animals are treated twice and by restraining the animals at treatment. Further, all pigs ought to be weighed before treatment since inadequate treatment of single pigs may hazard the success of eradication attempts (Hogg 1989). The danger of using a defined treatment dose for all sows was well elucidated by the heaviest sow in this study. She weighed 315 kg, which corresponds to a treatment dose of 9.5 ml doramectin (300 µg/kg body weight).

The success of the elimination attempts was in both herds supported by a failure to demonstrate live mites 20 months after the initial treatment. The demonstration of dead mites in 3 pigs one month post treatment did not alter this standpoint since dead mites may persist for a long period in ear-wax (Hogg 1984, Cargill et al. 1996, Jacobson et al. 1999).

Clinical signs associated with mange, such as skin lesions and rubbing intensity, also indicated success of the treatments since these signs remained at a low level following the acaricidal treatments. Introduction of mites to juvenile animals are reported to rapidly induce

signs of pruritus and papular dermatitis (Sheahan 1974, Cargill & Dobson 1979a, Bornstein & Zakrisson 1993). Therefore, failure of elimination attempts would certainly be obvious especially among naive piglets (Courtney *et al.* 1983, Bornstein & Zakrisson 1993).

Although the number of rubbings recorded per adult always was below one per animal during 15 min, the rubbing index of the adults did vary over time. The housing of dry sows in large deep straw-bedded pens located in un-insulated barns established seasonal climatic variations. The outdoor temperature may vary from the extremes of -40°C and +40°C over the year. The rubbing intensity was increased during the summer period in both herds, which corresponds to an overall increased activity of the animals (Fig. 2).

The success of the elimination attempts was also confirmed by decreasing levels of serum antibodies to *S. scabiei* among weaned piglets and breeding stock in both herds.

Acquired antibodies may remain for at least 9 months following acaricidal treatment (Bornstein *et al.* 1994). Care must therefore be paid to introduction of non-infected but seropositive replacement breeding stock when using serological methods as a tool to document freedom from infection. This dilemma was well elucidated in the present study. The initial mean absorbance level of serum antibodies to *S. scabiei* among all adults was 0.175 in both herds. In herd A, which remained at the size of 40 sows throughout the study, that value decreased to 0.11 eight months later. A similar decrease was not seen until 20 months post treatment in herd B. Four months after the treatment and onward, herd B increased the number of sows from 20 to 46 by purchase of seropositive gilts (data not shown). In the same context, decreasing levels of serum antibodies among weaners, following elimination attempts, may sometimes be difficult to certify in herds that exploit a low patho-

gen load, *i.e.* herds that previously have performed a strategic use of acaricides in age segregated rearing systems (Bornstein & Wallgren 1997). Serological monitoring for success of elimination attempts against *S. scabiei* must therefore be carefully planned and carried through.

In conclusion, it was found possible to eliminate *S. scabiei* using single or double intramuscular injections with doramectin without any other steps taken. It is important to use a proper administration and correct dosage of the drug. Regardless of strategy chosen, one must always consider the risk of reintroducing *S. scabiei* by purchase of pigs from herds with unknown mange status (Hogg 1984, Hogg 1989). Therefore, it is recommended to keep replacement animals in a quarantine for at least 3 weeks and, despite eventual previous treatments, treat these animals with an effective acaricide during this period.

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Sammanfattning

Eliminering av *Sarcoptes scabiei* från svinbesättningar via enstaka eller upprepad injektion med ivermectin.

Sanering mot svinskabb (*S. scabiei* var. *suis*) genomfördes i två smågrisproducerande besättningar. I besättning A behandlades samtliga individer med doramectin, två gånger med 14 dagars mellanrum. I besättning B behandlades samtliga individer med en enda injektion av doramectin. Ingen rengöring eller desinfektion av byggnaderna utfördes. Resultaten kontrollerades via skrapprov, klädindex och serologi avseende *S. scabiei*. Provtagning gjordes av samtliga vuxna djur och 15 smågrisar per

besättning, var fjärde månad i totalt 20 månader. Resultaten indikerar, att saneringarna lyckats i båda besättningarna och att det är möjligt att genomföra en skabbsanering med en enda avermektin-injektion till samtliga djur vid ett och samma tillfälle, utan att vidta några hygieniska åtgärder i omgivningen. Det

är dock viktigt, att en korrekt dosering och en korrekt injektionsteknik används. Likaså bör nyinköpta djur placeras i karantän i minst tre veckor och där behandlas två gånger, för att undvika att smitta reintroduceras i besättningen.

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