



# The Effect of Mycotoxins on Swine Fertility

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# The Effect of Mycotoxins on Swine Fertility

**Mycotoxins are found in most raw materials worldwide. The annual BIOMIN Mycotoxin Survey indicates an increasing incidence of co-contamination, where more than one mycotoxin is found in each sample. Mycotoxins have a direct and negative effect on reproductive performance in pigs, and mitigating these is essential in high-performing pig units.**



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Swine fertility has a significant effect on farm profitability and the number of pigs produced per sow per year is one of the factors that define production costs per pig. It is crucial to sustain high reproductive indices like litter size, number of farrowings per year and productive days.

Various parameters affect herd fertility, including:

- Management
- Genetics
- Nutrition
- Health
- Anti-nutritional factors

Mycotoxins are known anti-nutritional factors that affect reproduction and over 400 different mycotoxins have been identified to date. The most well-known are trichothecenes, zearalenone (ZEN), ochratoxins, aflatoxins, fumonisins and ergot alkaloids. Every raw material can be affected by more than one fungus, and each fungus can produce more than one mycotoxin, so it is highly likely that there will be more than one mycotoxin in any one feed ingredient (*Figure 1*).

This increases the chances that mycotoxins will interact and produce synergistic effects, which are of great concern for livestock health and productivity.

The *Fusarium* toxins deoxynivalenol (DON) and ZEN are a good example of co-contamination. These mycotoxins are mainly produced by *F. graminearum*, *F. culmorum*, and *F. roseum* (Tiemann and Dänicke, 2007).

## Direct effect on pigs

Pigs are usually considered to be the species that is most susceptible to mycotoxin contamination, with young animals and breeding females the most sensitive groups.

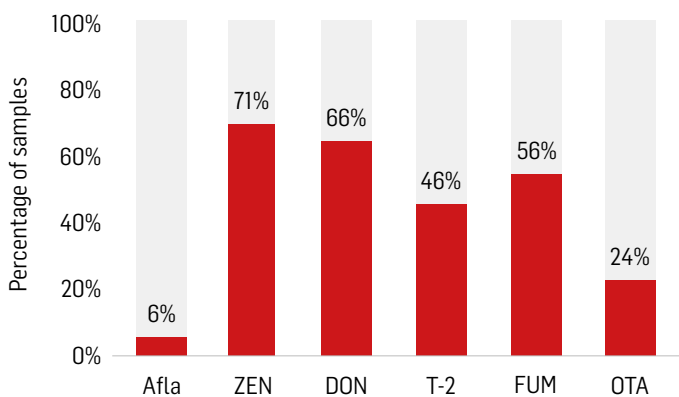
### IN BRIEF

- Mycotoxins are found in most raw materials worldwide.
- Pigs are very sensitive to mycotoxins, especially breeding females and piglets.
- Reproductive performance is directly and indirectly affected when feed is contaminated with mycotoxins.
- The effects of mycotoxins can be mitigated by adding Mycofix® to the diet.

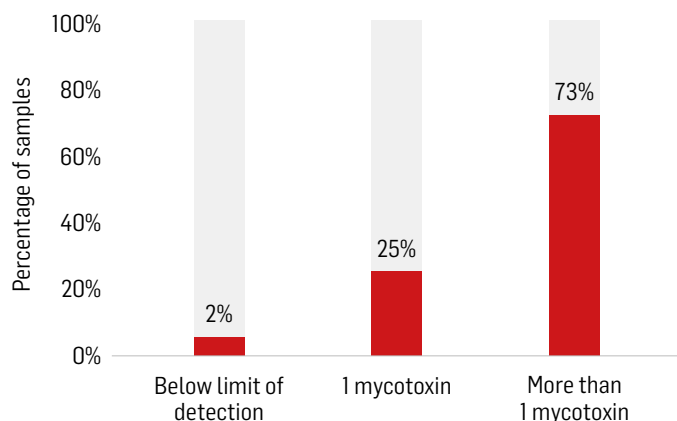
**Figure 1.**

Global mycotoxin prevalence from January to June 2018

All Regions - mycotoxin prevalence in all samples



Mycotoxin co-contamination in all samples - samples tested for at least 3 mycotoxins



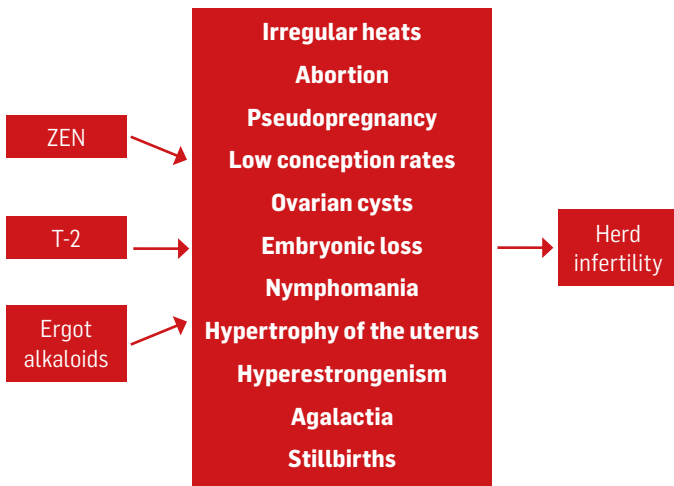
Source: BIOMIN Mycotoxin Survey



Photo: Gettyimages\_Jevic

Figure 2.

Direct effects of mycotoxins on reproductive performance



Source: BIOMIN

Figure 2 shows some of the direct effects of mycotoxins on reproductive performance.

### Zearalenone (ZEN)

ZEN is most notorious for its effects on reproduction (Table 1). It blocks normal hormone synthesis due to its resemblance to the estradiol molecule and competes for estradiol (estrogenic) receptors. This estrogenic effect

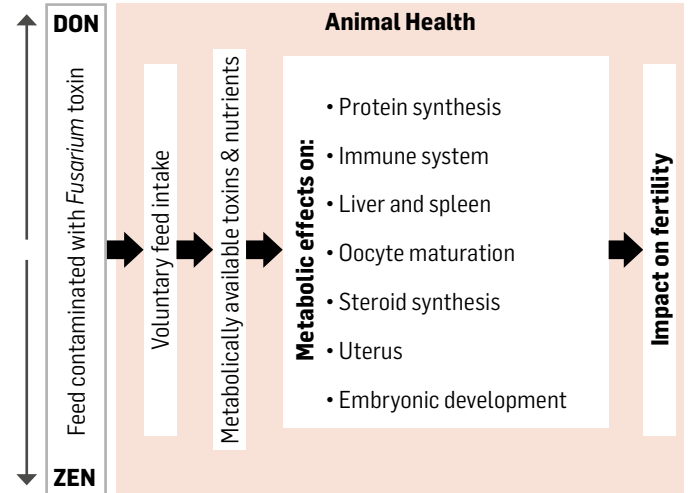
Table 1. Effects of ZEN in swine

Group	Effect	Consequences
Adult females	Reproductive	Altered reproductive cycle, conception, ovulation and implantation
		Pseudopregnancy, abortion, anestrus, nymphomania
		Embryonic death, inhibition of fetal development, reduced litter size, reduced birth weight
		Enlarged mammary glands
		Swollen and reddened vulva
		Rectal and vaginal prolapse
		Reddened teats
Adult males	Reproductive	Atrophied ovaries
		Uterine hypertrophy
		Feminization
		Enlarged mammary glands
Piglets	Teratogenic	Poor semen quality
		Testicular atrophy
		Swollen prepuce
Piglets	Teratogenic	Splay legs

Source: BIOMIN

Figure 3.

Combined effects of ZEN and DON on fertility



Source: Tiemann and Dänicke, 2007

disrupts the hypothalamic-pituitary-ovarian axis and suppresses secretion of the follicle-stimulating hormone (FSH) in the ovaries, disrupting the endocrine system.

### Deoxynivalenol (DON)

If DON is present in feedstuffs, it compromises feed intake and may cause vomiting (Diekman and Green, 1992). It also inhibits protein synthesis, alters the immune system response and causes reproductive problems by targeting oocyte and embryo development (Pestka *et al.*, 2004; Alm *et al.*, 2006).

The effect of DON on reproduction in pigs is more indirect (Figure 3) as the lower feed intake reduces nutrient availability and poses a threat to the metabolic pathways in the reproductive system. Any dysfunction of the vital organs that have a key role in metabolism, such as the liver and spleen, also has an adverse effect on health. Once health is compromised, metabolic priorities change and the requirements of the reproductive system move lower on the list of priorities (Kanora and Maes, 2009).

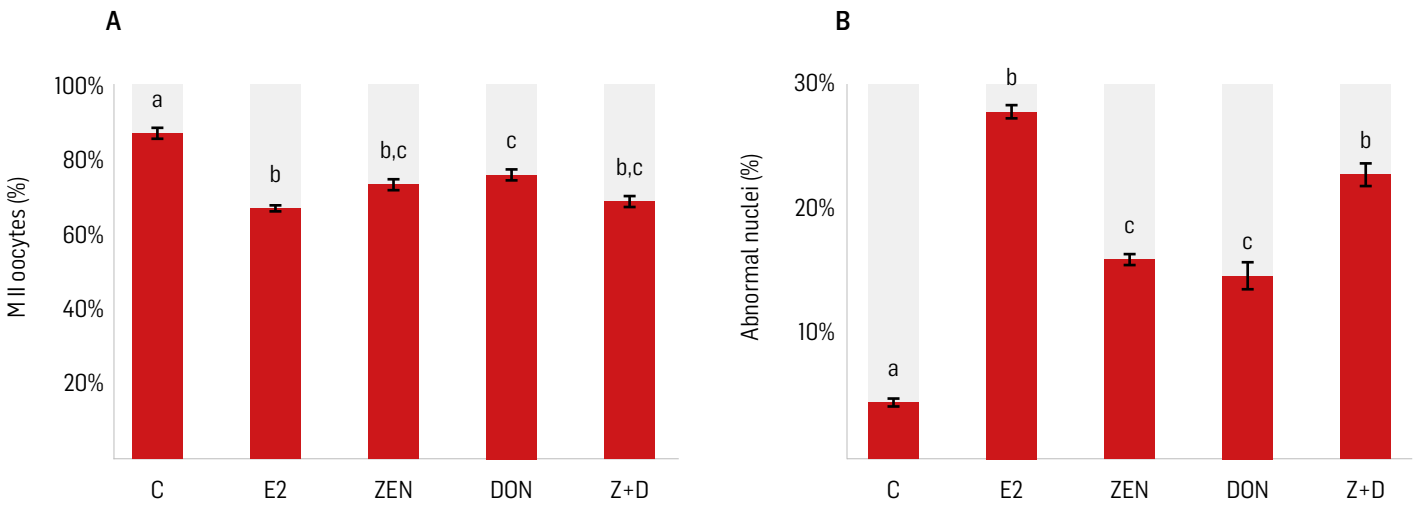
### Follicle development, oocyte maturation and embryo development

*In vitro* studies of porcine oocytes have shown that ZEN, DON or a combination of ZEN and DON disrupt oocyte development (Figure 4), making them unable to mature. This may compromise embryo viability, maintenance of pregnancy, and birth weight. DON had the most potent effect on embryo development after fertilization, resulting in fewer and abnormal blastocysts.

In a recent trial contracted by BIOMIN at the University of Berlin, Institute for Animal Nutrition, Department of Veterinary Medicine, the reproductive performance of sows challenged with DON and ZEN during long-term (three-cycle) exposure to *Fusarium* toxins was investigated. Sows

**Figure 4.**

Exposure to estradiol, ZEN, DON, and ZEN + DON significantly reduced the percentage of oocytes that reached metaphase II (M II) (A) and significantly increased nuclear abnormalities in the oocyte (B).



C = control, E2 = estradiol, ZEN = zearalenone, DON = deoxynivalenol, Z+D = zearalenone plus deoxynivalenol. Different letters indicate significant differences between columns.

Source: Malekinejad et al., 2007

**Table 2.**

Summary of trial groups and diets

Group	Diet
Control	Uncontaminated feed
Toxin	Feed contaminated with high levels of DON and medium levels of ZEN
Trial	Feed contaminated with high levels of DON and medium levels of ZEN, and supplemented with Mycofix® Plus

Source: BIOMIN

were allocated to one of three different groups, as per *Table 2*.

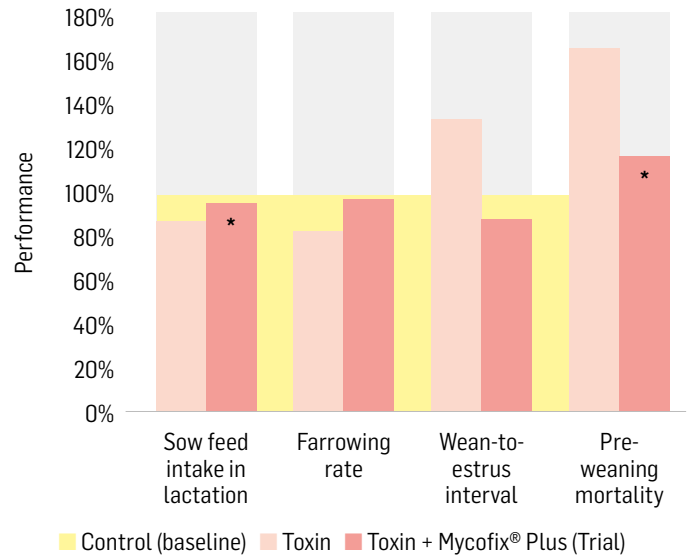
The results in *Figure 5* show that the mycotoxins impaired various reproductive parameters. The most common index of reproductive performance is the number of piglets weaned per sow per year. Farrowing rate and wean-to-estrus interval both affect this index. The presence of mycotoxins, especially ZEN, increased returns to heat in inseminated sows and reduced the farrowing rate.

Feed intake fell, affecting the sows' body condition score at weaning and their milk yield. Underweight sows take longer to come into estrus after weaning, which reduces the number of farrowings per year, so fewer weaned piglets are produced per sow per year. Lower milk yields could also compromise litter growth and weaning weights, resulting in lower weights at slaughter or more days on feed.

Mycotoxins also affected piglet quality (*Figure 6*): the

**Figure 5.**

Effects of ZEN and DON on reproductive indices. The yellow area represents the control group, presented as 100% performance.



\* statistically significant differences ( $P < 0.05$ ).

Source: BIOMIN

percentage of underweight piglets (<1.2 kg) increased, suggesting that mycotoxins have a detrimental effect on embryo development and maternal nutrition. This negative effect on piglet quality, accompanied by the reduction in milk yield, may increase pre-weaning mortality and reduce weaning weights.

However, animals recovered well when Mycofix® Plus was added to the diet.

### Multiple mycotoxins; many consequences

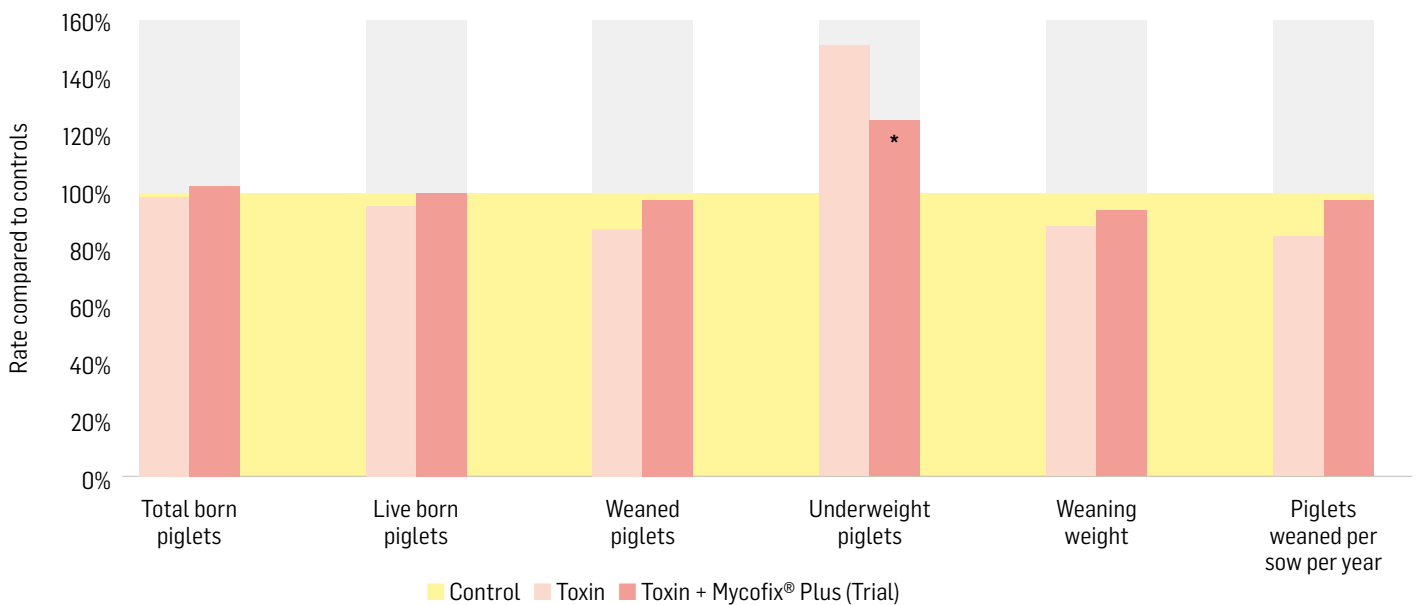
Mycotoxin co-contamination of raw materials is more common than contamination with a single mycotoxin, as routinely reported in the BIOMIN Mycotoxin Survey. Each mycotoxin acts in a specific manner and affects multiple tissues, organs and functions. When combined, these

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challenges cause a myriad of different clinical or subclinical signs, often not linked to the known effects of direct mycotoxin contamination in animals.

**Figure 6.**

Effect of ZEN and DON on reproductive indices. The yellow area represents the control group, presented as 100% performance.



\* statistically significant differences ( $P < 0.05$ ).

Source: BIOMIN

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