J S Afr Vet Assoc. 2025;96:33-38
https://doi.org/10.36303/JSAVA.662

J S Afr Vet Assoc
ISSN 2224-9435 EISSN 1019-9128

CASE REPORT

First report of a Sporidesmin Toxicity (Facial Eczema) outbreak in a South African dairy herd

AJ Davis,[1,2] DDPS Jordaan,[3] JG Myburgh[2]

[1] *Humansdorp Veterinary Clinic, South Africa*
[2] *Department of Paraclinical Sciences, Faculty of Veterinary Science, University of Pretoria, South Africa*
[3] *Department of Agricultural Economics, Extension and Rural Development, Faculty of Natural and Agricultural Sciences, University of Pretoria, South Africa*
Corresponding author, email: *anthony@humvet.co.za*

Sporidesmin, a toxin released by a saprophytic fungus, *Pseudopithomyces chartarum*, causes hepatogenous photosensitivity in sheep and cattle, commonly known as Facial Eczema. A recent outbreak in the Eastern Cape Province of South Africa caused significant direct and indirect economic losses to a farmer in the area and highlighted the potential negative consequences of this mycotoxicosis to the dairy industry in this province. The milking herd consisted of 400 cross-bred Jersey/Friesian/Montbilliard cattle. The farmer identified 56 cows showing teat sensitivity/irritability during milking, hypersensitive skin, excessive licking and/or obvious skin lesions on non-pigmented skin areas. Three were culled due to the severity of their skin lesions. Grazing consisted of mixed kikuyu/perennial rye grass pasture under pivot irrigation, alternated with dryland kikuyu/Italian rye and sorghum. Typical clinical signs of severe secondary photosensitivity (skin inflammation and hypersensitivity to touch), very high serum concentrations of Gamma-Glutamyl Transferase (GGT 2143-5177 IU/L) and detection of large numbers of spores on grazed planted pastures supported the clinical diagnosis. Supplementation of zinc oxide (ZnO) powder at 12g per 500 kg cow dosed individually over the concentrates fed in the dairy, effectively reduced the incidence of new cases within two to three weeks. Weight loss, a decrease in milk volume and solids, and increased somatic cell counts were observed during this outbreak. One of these parameters, milk volume loss, was quantified by comparing the financial records of the four years preceding the outbreak to the production figures during the outbreak. The farmer lost approximately R1.5 million in milk volume during this outbreak (November 2020 – April 2021). Long term consequences were also apparent: the culling rate within the clinically affected group of 53 cows was more than 50% higher than the rest of the herd over the following two years. This case study highlights the urgent need to investigate the prevalence and potential economic impact of Sporidesmin Toxicity on the South African pasture-based dairy industry.

Keywords: facial eczema, *Pseudopithomyces chartarum*, sporidesmin toxicity, perennial ryegrass, hepatogenous photosensitivity, GGT, zinc oxide, milk solids, dairy cattle, economic impact

Introduction

Facial Eczema (FE) is a descriptive term for a secondary photosensitivity caused by ingestion of the toxin, sporidesmin, produced by the fungus, *Pseudopithomyces chartarum,* previously named *Pithomyces chartarum* (Ariyawansa et al. 2015). It was first recognised in sheep in New Zealand (Brook and Mutch.1964; Di Menna et al. 2009). Animals consume sporidesmin when they graze pastures contaminated by the spores of this fungus. Reports of this toxicity in either sheep or cattle have been received from various countries including New Zealand, Australia, Spain, Turkey, France, Netherlands, Uruguay and USA (Oregon) (Di Menna et al. 2009; Collin et al. 1998).

P. chartarum is a widely distributed fungus and weather conditions associated with sporulation are well described (Mitchell et al. 2011). Typically, a small amount of rain, followed by high grass temperatures (over 12°C) and 100% humidity have been identified as critical determinants for sporulation. FE is well known in New Zealand and has a major impact on herd productivity (Di Menna et al. 2009; Cuttance et al. 2016). Optimal hepatic function is vital for a high-producing dairy cow, so it is feasible that even if the typical clinical signs of photosensitivity are not evident, this toxicity will hamper production and reduce the financial efficacy of affected dairies.

Clinical signs of sporidesmin toxicity are related to its hepatotoxity, and typical secondary photosensitivity induced by the toxin. In dairy cattle the disease is recognised clinically by lesions on non-pigmented areas of the skin including udder and teats, vulva, muzzle, eyelid margins and other non-pigmented skin areas. Subclinical effects include a decrease in milk yield, milk solids, and a general loss of body condition. Economic consequences relate to loss in milk yield and milk solids, weight loss, poor long-term productivity, and treatment costs of clinical cases (Cuttance et al. 2021; Towers 1978).

There is no specific treatment for sporidesmin toxicity, but there is an effective way to prophylactically reduce the effects of the toxin by supplementing cattle with zinc oxide three weeks prior to an outbreak (Munday 1984; Smith et al. 1984). This can only be done by monitoring *P. chartarum* spore counts and commencing zinc oxide treatment when counts are consistently between 10 000 and 20 000 spores per gram. (Di Menna & Bailey 1973; Smith & Embling 1999; Cuttance et al. 2016).

Table I: A comparison of changes in chemical indicators of liver pathology

COW NR	GGT (0–20 IU/L)	BILIRUBIN CONJ (0–3.4 UMOL/L)	BILIRUBIN UNCONJ (2–14 UMOL/L)	AST (0–196 IU/L)
17002	5177	17	33	398
16011	2943	12	15	*Nt
14083	2143	1	3	131
12093	4926	7	8	280
14113	4451	Nt	Nt	Nt
13050	2983	Nt	Nt	Nt
15039	3384	Nt	Nt	Nt
17094	3672	Nt	Nt	Nt

*Nt=not tested

FE was well-described by Marasas et al. (1972) when an outbreak occurred in sheep in the Humansdorp area, but there are no published reports of this toxicity in dairy cattle in South Africa, even though the condition is known by farmers, especially in the Tsitsikamma area. Outbreaks in 1967, 1970 and 1971 described by Marasas et al. (1972) were in sheep grazing *Lolium perenne* (perennial ryegrass)/*Trifolium repens* (white clover) pastures. The fungus was also isolated from *Sporobulus capenis*. Fungal spores were found, and the fungus confirmed to be *Pithomyces chartarum*, now known as *Pseudopithomyces chartarum* (Ariyawansa et al. 2015).

Several years later, an epidemiological survey of South African *P. chartarum* isolates, demonstrated that most strains isolated in South Africa were non-toxigenic (Kellerman et al. 1980; Kellerman & Coetzer 1985), so at that time, the toxicity did not seem to be of much economic significance. However, the agricultural landscape in the Eastern Cape has changed significantly during the past 40–50 years, most notably the widespread use of perennial ryegrass as the key component of mostly pasture-based grazing platforms for dairy cattle. Since perennial ryegrass is a favoured substrate for *Pseudopithomyces chartarum* (Brook 1963), the population dynamics of this fungus may also have changed dramatically over the past 50 years.

The aim of this Case Report is to describe a clinical sporidesmin toxicity outbreak in a dairy herd and to report the potential financial losses suffered by the farmer during this outbreak in the Humansdorp district.

Sporidesmin toxicity outbreak in the Eastern Cape

History of the outbreak, clinical findings on farm and tentative diagnosis

A dairy farmer in the Oyster Bay area, Eastern Cape, (close to the sea) with 400 cows in milk, noticed an acute decrease in milk production from November 2020 to April 2021. The farm practises a seasonal breeding season, so milk yield varies according to stage of lactation, but historical average milk yield for this farm is 16.5l/cow (See Table II). In mid-January 2021, the farmer noticed that cows had high fevers (> 40 °C) and dairy parlour staff reported difficulty milking these cows. These cows were particularly irritable after being dipped. The dip strength was investigated and confirmed to be correct. Several cows were licking themselves excessively. A total of 56 cows of the 400 cows in the milking herd were identified with similar clinical signs that ranged from skin sensitivity to obvious lesions on non-pigmented areas of skin, including muzzle crusting, reddened vulvas and eyelid margins, chafed udders and reddened teat skin (Figures 1–3). Three of these cows necessitated slaughter due to the severity of their lesions and their extreme level of discomfort.

Table II:

Parameter	
2016-2019 annual average litres milk/cow/day (2016–2019)	**16.5 L**
Outbreak year average (Nov 2020–April 2021)	**13.5 L**
Difference in litres/cow/day between 2016-2019 average and 2020/2021	**3.0 L**
Total income loss/400 cows at R6.80/l/day (Nov 2020–April 2021)	**R1 500 000**
4-year average milk solids/body weight percentage (2016–2019)	**92%–97%**
Outbreak-year average (Nov 2020–April 2021)	**87%**
Average annual historical culling rate for this herd	**10–15%**
2021 culling rate (percentage of herd)	**28%**
2021 culling rate (percentage of herd)	**26%**

During a vet visit (AJD), eight of these cows were examined clinically and blood samples from these cows were collected from the caudal tail vein into BD Vacutainer® serum tubes for blood chemistry and sent to Pathcare Laboratories, Jeffrey's Bay for Gamma-Glutamyl Transaminase (GGT), Aspartate Transaminase (AST) and bilirubin.

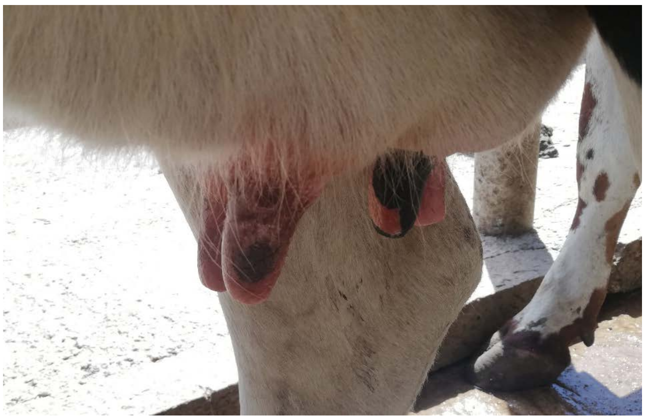

Figure 1: Reddened teats with crusty exudate due to acute photosensitivity

Figure 2: Reddened non-pigmented (white) udder skin

Figure 3: Non pigmented areas of nose and muzzle oozing serous fluid and forming crusts

A total of 56 cows out of a group of 400 cows showed signs of photosensitivity. Cows rotated between perennial rye grass/ kikuyu under pivot and dryland perennial rye grass pastures. Grazing was supplemented with silage and with concentrate meal in the parlour.

Laboratory results, confirmation of diagnosis and control of outbreak

GGT is a useful indicator of sporidesmin toxicity (Towers & Stratton 1978; Cuttance et al. 2021), so this was measured in these eight affected cows. GGT concentrations were extremely high (mean: 3308 IU/L, range 2143–5177 IU/L, normal values 0–20 IU/l) measured in the eight cows tested (Table I). In three out of four cows tested, conjugated bilirubin concentrations were increased (mean: 12 UMOL/L, range 7–17 UMOL/l, normal values 0–3.4 UMOL/L). AST was only increased in one out of four cows tested (mean: 270 IU/L, range 131–398 IU/L, normal values 0–196 IU/L). These results indicate significant bile duct pathology, which is typical of sporidesmin toxicity.

Grass samples from the grazed perennial ryegrass and kikuyu pastures were collected and processed according to Di Menna's method (Di Menna & Bailey 1973), and the characteristic spores of *Pseuodopithomyces chartarum* were found (Figure 4). The standard haemocytometer count method was not in routine use in South Africa at this time, so instead, spores were counted in one drop of wash water placed under a standard-sized coverslip. Over 200 *P. chartarum* spores were counted under 100X magnification using a light microscope.

Pasture samples were collected and sent to the Forestry and Agricultural Biotechnology Institute (FABI). The fungus was positively identified as *Pseudopithomyces chartarum* by FABI, UP (Yilmaz, N. unpublished data).

Acriflavine-glycerine smeared onto udder skin and teats effectively reduced the skin irritation. Additional supportive therapy for severe cases with secondary skin infection included: an intramuscular injection of long-acting penicillin at a dose of 1 ml/10kg (15 000 IU (15 mg)/kg penicillin G procaine with 15 000 IU (11.25 mg)/kg penicillin G benzathine (30 000 IU penicillin per kg) (Duplocillin®, MSD), repeated after two days; a single subcutaneous injection of an anti-inflammatory drug, 0.5 mg/ kg meloxicam (Inflacam®, Virbac); and an intramuscular injection of 20 ml (100 mg) once daily for three days of a liver stimulant (Tioctan Vet®, Kyron Laboratories).

Retrospective calculations of the financial losses

Several economically important consequences were associated with this outbreak (See Table II). These included: weight loss, a decrease in milk volume and milk solids, increased somatic cell counts and poor return to oestrus.

To quantify loss of milk yield, the financial records of the four years preceding the outbreak were compared to the milk production figures during the outbreak. The difference in average milk volume produced/cow/day between the four-year average and the year of the outbreak were calculated and multiplied by the number of cows in milk and the milk price (Table II).

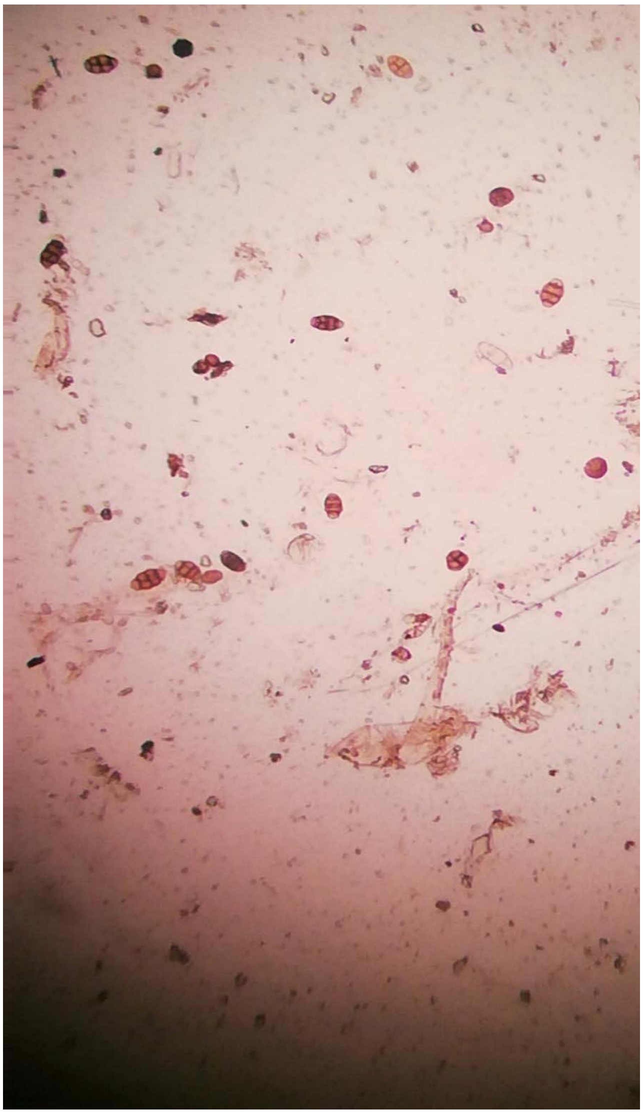

Figure 4: *Pseudopithomyces chartarum* spores in perennial ryegrass leaf washings

To assess the long-term consequences of this outbreak, the farmer counted the number of cows culled from the group of 53 cattle identified as clinical cases during the outbreak (Table II) and calculated that 54% of this group of cows were culled within two years of the outbreak. Prior to this outbreak the culling rate over two years was 20–30%, so 54% over two years is higher than expected.

Discussion

The outbreak described above was severe and unprecedented. This is an on-farm case-study, not a controlled experimental trial, so within this complex environment, numerous variables could have contributed to the clinical picture, but liver pathology and photosensitivity clearly characterised this outbreak. The farmer's observations of skin irritation and discomfort during milking were typical clinical signs of photosensitivity. Clinical chemistry confirmed significant liver (mostly bile duct) pathology. Pasture samples confirmed the presence of large numbers of typical *P. chartarum* spores, the causative agent of sporidesmin toxicity (Facial Eczema).

In discussion with dairy farmers, periodic cases of photosensitivity are well known to them, but mostly do not cause alarm and most cattle respond to treatment. Sporulation of *P. chartarum* is very dependent on suitable weather conditions, so outbreak severity varies from season to season (Brook 1963). The Eastern Cape area experienced a prolonged drought, and this is a factor known to suppress outbreaks of sporidesmin toxicity. The combination of improved rainfall in 2020, high ambient temperatures, accompanied by high humidity in December 2020, would have created conditions conducive to sporulation. Irrigation of the camp may also have increased humidity even further, creating ideal conditions for sporulation.

Besides the clinical impact on dairy cattle in this herd, a significant consequence of this outbreak is to alert South African pasture-based dairy farmers of the potential harmful effects of this toxin. The clinical manifestation is obvious, but the subclinical effects are not as easily seen and are economically significant (Di Menna et al. 2009). New Zealand and Australia have known this toxicity for more than a century and the economic consequences of subclinical FE are well described (Cuttance et al. 2016; Towers 1978). This toxicity has never been investigated in South African dairy cattle, and since pasture-based dairy farming is the backbone of the dairy industry in many areas of the country, especially the Eastern Cape, improved understanding of the impact of this toxin is necessary.

Although photosensitivity is an obvious manifestation of this toxicity, it is not the most significant driver of economic loss. The seriousness of the condition is easily overlooked and in the authors' opinion, the term "Facial Eczema" is not alarming enough. The term "Facial Eczema" was an apt description for the typical clinical signs associated with this toxicity in sheep. Sheeps' faces typically swell and the skin peels off in places, justifying the term "Facial Eczema". However, in dairy cattle, this term is a misnomer and belies the very serious damage done to liver tissue. We propose that "Sporidesmin Toxicity" is a more appropriate term to describe this condition in dairy cattle.

Prophylactic control of sporidesmin toxicity is possible using zinc salts. Zinc salts "deactivate" sporidesmin (Munday 1984) and prophylactic inclusion of this in the ration is practised routinely in New Zealand to reduce the impact of this toxicity (Di Menna et al. 2009). Timing of zinc oxide inclusion is extremely important. When regional spore counts reach 20 000 spores per gram plant material, it is general practice to commence ZnO supplementation (Di Menna et al. 2009). ZnO begins to work optimally three weeks after inclusion, and it generally takes three weeks for spore counts to increase from 20 000 to the toxic count of 100 000 (Cuttance et al. 2017). Supplementing three weeks prior to the "toxic period" allows time for ZnO to reach protective levels. For this reason, regional spore counts are the cornerstone of sporidesmin toxicity management and due to variability between farms, should be followed up by on-farm spore counts and climate monitoring.

It is not advisable to commence zinc oxide treatment during an outbreak since feeding zinc salts to cattle that have already been exposed to sporidesmin toxin can have negative health consequences. Smith and Embling (1999) demonstrated that sheep exposed to sporidesmin and then dosed with zinc oxide were more likely to develop pancreopathy than sheep dosed prophylactically, i.e. before they were exposed to sporidesmin (Smith & Embling 1999). Zinc oxide supplementation is also associated with hypocalcaemia (Smith et al. 1984). On this farm, the economic impact was already severe and despite these potential negative consequences, inclusion of zinc oxide was commenced immediately at 12 g per cow per day. The zinc oxide was hand-dosed individually to each cow in the milking parlour by adding it to their concentrate meal. New cases were no longer seen two to three weeks after commencement of supplementation. It was also possible to offer cattle an alternative forage source when high spore counts were detected, so grazing management can also play a fundamental role in the management of sporidesmin toxicity.

Financial losses in this outbreak were associated with a decrease in milk yield, drop in milk solids, loss of condition, decreased longevity, and an increase in somatic cell counts. There was a clear decrease in milk production and in milk solids during the year of the outbreak. Milk yield loss compared to an average of the four years prior to this outbreak is estimated at R1 500 000 over six months (Table II). A drop in milk volume is described in outbreaks (Towers 1978). On this farm, milk solid production is monitored using a calculation to evaluate milk solid production as a percentage of body mass. This is calculated by dividing the total mass of milk solids sold for the season by the number of cows milked for that season, expressed as a percentage of body weight. The average percentage for four years prior to the outbreak ranged between 92% and 97%, but during the year of the outbreak, this reduced to 87%.

Cuttance et al. (2021) confirmed that cows exposed to sporidesmin lose milk solids, and quantified this loss based on GGT concentrations.

The farmer kept record of the 53 cows that were obviously clinically affected during this outbreak. In 2021, 15 cows from this group were culled (28,3%) and in 2022, a further 14 were culled (26.4%), so 54.7% of the clinically affected cows were removed from the herd within two years. The historical culling rate prior to this outbreak for this herd is 10–15% per annum, so in 2021 and 2022, thus the culling rate was higher than expected. This trend has also been described in a longevity study performed on Jersey cows (Morris et al. 2010). Chronic exposure to sporidesmin causes fibrosis of the bile ducts and necessitates regeneration of the liver for the cow to recover (Peters 1963). Since the liver is central to all metabolic processes, damage to this organ will negatively affect production.

Other economically important factors which were not quantified in this outbreak included somatic cell counts and body condition score. The farmer noticed that cows shifted around in parlour and this discomfort most likely contributed to an increase in somatic cells. Many cows lost condition during the outbreak and required additional feeding to regain condition before calving. Cows in poor condition do not conceive well, so this is another indirect consequence of this toxicity.

Other costs to the farmer included the cost of adding zinc oxide to the ration as a prophylactic measure, treatment costs of clinically affected cows and cost of feed to cows that had lost condition during the outbreak (Table I). Zinc oxide prophylaxis in 2021 cost 82c/cow/day, so for a 400-cow farm this costs R328/day, which is a minimal expense compared to the potential losses.

The outbreak in this dairy herd was severe and highlights the need to explore the impact of this toxicity on other pasture-based dairy farms along the coast, further inland and in other areas where pasture-based dairy farming is practised. Population genetic studies of this fungus, focused investigation of the clinical effect on cattle during sporidesmin toxicity season, and the prevalence of the condition in South Africa are all important aspects requiring further study.

ORCID

AJ Davis https://orcid.org/0000-0002-9158-9820

DDPS Jordaan https://orcid.org/0000-0002-6736-1789

JG Myburgh https://orcid.org/0000-0002-2132-7251

References

Ariyawansa, H.A., Hyde, K.D., Jayisi, S.C., et al, 2015, Fungal diversity notes 111-252-taxonomic and phylogenetic contributions to fungal taxa, *Fungal Diversity* 75, 27-274. https://doi.org/10.1007/s13225-015-0346-5.

Brook, P.J., 1963, Ecology of the fungus *Pithomyces chartarum* (Berk & Curt) M.B. Ellis in pasture in relation to facial eczema disease of sheep, *New Zealand Journal of Agricultural Research* 6, 147-228. https://doi.org/10.1080/00288233.1963.10418130.

Brook, P.J., Mutch, G.V., 1964, Field control of facial eczema of sheep, *New Zealand Journal of Agricultural Research* 7, 138-145. https://doi.org/10.1080/00288233.1964.10418146.

Collin, R.G., Odriozola, E., Towers, N.R., 1998, Sporidesmin production *by Pithomyces chartarum* isolates from Australia, Brazil, New Zealand and Uruguay, *Mycological Research* 102, 163-166. https://doi.org/10.1017/S0953756297004905.

Cuttance, E.L., Laven, R.A., Stevenson, M.A., 2017, Variability in measurement of *Pithomyces chartarum* spore counts, *N Z Vet J* 65, 192-197. https://doi.org/10.1080/00480169.2017.1303794.

Cuttance, E.L., Mason, W.A., Laven, R.A., 2021, The association of milk-solid production during the current lactation with liver damage due to presumptive ingestion of spores from *Pithomyces chatarum* by dairy cattle, *N Z Vet J* 69, 201-210. https://doi.org/10.1080/00480169.2020.1861570.

Cuttance, E.L., Stevenson, M.A., Laven, R.A., et al., 2016, Facial eczema management protocols used on dairy farms in the North Island of New Zealand and associated concentrations of zinc in serum, *N Z Vet J* 64, 343-50. https://doi.org/10.1080/00480169.2016.1220846.

Di Menna, M.E., Bailey, J.R., 1973, *Pithomyces chartarum* spore counts in pasture, *New Zealand Journal of Agricultural Research* 16, 343-351. https://doi.org/10.1080/00288233.1973.10421114.

Di Menna, M.E., Smith, B.L., Miles, C.O., 2009, A history of facial eczema (pithomycotoxicosis) research, *New Zealand Journal of Agricultural Research* 52, 345-376. https://doi.org/10.1080/00288230909510519.

Kellerman, T.S., Coetzer, J.A., 1985, Hepatogenous photosensitivity diseases in South Africa, *Onderstepoort J Vet Res* 52, 157-73.

Kellerman, T.S., Van der Westhuizen, G.C., Coetzer, et al., 1980, Photosensitivity in South Africa. II. The experimental production of the ovine hepatogenous photosensitivity disease geeldikkop (Tribulosis ovis) by the simultaneous ingestion of Tribulus terrestris plants and cultures of *Pithomyces chartarum* containing the mycotoxin sporidesmin, *Onderstepoort J Vet Res* 47, 231-61.

Marasas, W.F., Adelaar, T.F., Kellerman, T.S., et al., 1972, First report of facial eczema in sheep in South Africa, *Onderstepoort J Vet Res* 39, 107-12.

Mitchell, K.J., Walshe, T.O., Robertson, N.G., 2011, Weather conditions associated with outbreaks of facial eczema, *New Zealand Journal of Agricultural Research* 2, 584-604. https://doi.org/10.1080/00288233.1959.10418037.

Morris, C.A., Hickey, S.M., Denicolo, G., et al., 2010, Lifetime survival of Jersey-sired cows following natural challenge with facial eczema during first lactation, *New Zealand Journal of Agricultural Research* 45, 165-170. https://doi.org/10.1080/00288233.2002.9513506.

Munday, R., 1984, Studies on the mechanism of toxicity of the mycotoxin sporidesmin. 3–Inhibition by metals of the generation of superoxide radical by sporidesmin, *J Appl Toxicol* 4, 182-6. https://doi.org/10.1002/jat.2550040405.

Peters, J.A., 1963, Mechanism of early sporidesmin intoxication in sheep, *Nature* 200, 286. https://doi.org/10.1038/200286a0.

Smith, B.L., Collier, A.J., Lawrence, R.J., et al., 1984, Hypocalcaemia associated with high dose rates of zinc oxide to lactating dairy cows, *N Z Vet J* 32, 48-50. https://doi.org/10.1080/00480169.1984.11728697.

Smith, B.L., Embling, P.P., 1999, Effect of prior sporidesmin intoxication on the pancreopathy associated with zinc oxide toxicity, *N Z Vet J* 47, 25-7. https://doi.org/10.1080/00480169.1999.36103.

Towers, N.R., 1978, The incidence of sub-clinical facial eczema in selected Waikato dairy herds, *N Z Vet J* 26, 142-5. https://doi.org/10.1080/00480169.1978.34522.

Towers, N.R., Stratton, G.C., 1978, Serum gammaglutamyl transferase as a measure of sporidesmin-induced liver damage in sheep, *New Zealand Veterinary Journal* 26, 109-112. https://doi.org/10.1080/00480169.1978.34508.