Seaweed antioxidant combats fescue toxicity

When a team from Texas Tech and Virginia Tech looked into suppressing fescue toxicosis in cattle, they discovered that sprinkling the pasture with seaweed resulted in a fortified forage that could also have a positive effect on human health.

By Sarah Mellor

Tall fescue (*Festuca arundinacea*) is the most important cool-season grass in US pastures and provides the primary ground cover for some 14 million hectares (35 million acres). This versatile perennial grass is highly tolerant of a wide range of management regimes and produces good forage yields, with good nutrient composition. It is therefore a popular choice for pasture, especially in beef production systems.

Unfortunately, much of the benefits from the crop's superior agronomic characteristics have not been realised, as this forage crop is commonly associated with toxicity disorders in cattle, sheep and horses. Cattle grazing fescue often develop a number of chronic conditions known as *fescue toxicosis* (or summer slump), *fescue foot* and *abdominal fat necrosis*, of which fescue toxicosis is the most common. Clinical signs of fescue toxicosis include reduced weight gain, decreased milk production, poor appetite, retention of winter coat, reproductive problems and elevated rectal temperature, with or without diarrhoea. Animals tend to spend much of their time seeking out shady areas, due to their high body temperature and inability to lose their winter coats, therefore spending less time eating. Signs tend to appear in the warmer months, but have been reported at other times of the year.

Tall fescue is a popular choice for pasture in the US.

It is estimated that production losses due to fescue toxicosis cost the US beef industry some $600 million per year in lost cattle or low carcass weight.

A necessary evil

The toxicity of fescue forage is not a product of the plant itself, but that swards are associated with a microscopic endophytic fungus, *Neotyphodium coenphialum*. Removing the cattle from infected pastures affords reversal in the toxicity symptoms. Removing the fungus, however, is not a viable option. *Neotyphodium* grows between the cells of the plant, and the two exist in symbiosis, the plant affording nutrient and shelter, and receiving protection from a number of diseases and insect pests. Removing the fungus using fungicides is difficult, due to the integrated nature of the plant-fungus interaction, but also exposes the fescue to increased stress, reducing its agronomic value. Although fungus-free pas-

tures do exist, and low-fungus varieties have been bred (Johnson, 1985), eliminating the clinical effects of toxicosis or removing the toxin altogether is a more economically viable option.

A study at the Auburn Fescue Diagnosis Center showed that the breadth of the endophyte infection is extensive. Plant samples taken from 26 states, representing every region of the country, had a mean infection rate of 58%. Plants infected with the fungus tend to be hardier and more resistant to drought, over-grazing and insect damage.

Tackling the problem

Teams from the Crop Science Department at Texas Tech University (led by Professor Vivien Gore Allen) and from the Large Animal Clinical Sciences Department of Virginia Tech (headed by Dr Korin Saker) have pooled their expertise in both plant and animal aspects of the disease. Saker and her colleagues had already researched aspects of the disease and found that affected animals were deficient in copper. Administration of a copper bolus did improve the symptoms somewhat, supporting suspicions that the onset of the disease might be triggered by a copper deficiency. However, when she joined forces with Professor Allen's team, who had been looking at aspects of the fescue-fungus relationship, the two groups advanced more quickly. Professor Allen's group (Fike *et al.*, 2001) had been working with a commercially-produced brown seaweed, *Ascophylum nodosum* (Tasco-Forage, Acadian Sea Plants, Nova Scotia). Initial results with sheep and steers showed that seaweed-treated fescue infected with the fungus tended to improve daily weight gains, serum vitamin A and whole blood selenium contents of lambs, compared to those grazing on untreated pasture. In an experiment with Angus and Angus-Hereford crossbred steers, infected fescue forage was found to cause a reduction in serum vitamins A and E, and tended to have lower blood selenium compared to those fed uninfected fescue. Topdressing the forage crop with seaweed decreased serum vitamin E but tended to increase whole-blood selenium. The conclusion was that the endophytic fungus seemed to decrease antioxidant activity in grazing steers, whereas adding seaweed to the crop seemed to increase antioxidant activity in both the forage and the grazing ruminant. Moreover, adding seaweed to the crop was a cheaper, less labour intensive and longer-lasting effect than the copper bolus results of Dr Saker's work.

Fighting toxicity

Further collaborative work continued in beef steers, on a larger scale and longer studies. Saker *et al.* (2001) dissolved an extract of the seaweed in water at a concentration of 3.4kg/ha and applied it to pastures in April before grazing began and again in July at the same rate. The grazing period lasted until September. Total gains were higher for steers grazing uninfected pasture than for those grazing endophyte infected pasture. Rectal temperatures were increased in all steers grazing infected pasture, but was decreased in those whose forage had been treated with the seaweed extract, though this effect varied with location. Similarly, the effects on hair, coat and colour was partially offset by the use of seaweed.

Allen *et al.* (2001) also found that blood samples from steers fed seaweed-nourished fescue showed evidence of increased levels of some factors associated with increased immunity. This is thought to be due to the increased levels of antioxidants such as copper, vitamins C and E, superoxide dismutase and glutathione reductase. However, more work needs to be completed before the link is made between this and the increased immune status of the animals.

Commercial success ahead

It would appear that there is commercial success available through the use of seaweed extract. Professor Allen, Dr Saker and their colleagues have already received three patents covering seaweed supplementation. Several more patents are pending, and the whole portfolio is licensed to the manufacturer of the seaweed extract.

Further work has suggested that steers fed seaweed-treated forage had higher marbling scores (Allen *et al.*, 2001), regardless of whether the fungus was present, though no effect of either seaweed or endophyte on weight gain was evident in this study. The group did find, however, an effect on meat quality (in terms of its sensory characteristics), shelf-life and vitamin E status in meat from steers fed seaweed-treated fescue forage (Montgomergy *et al.*, 2001). This may mean that not only are the cattle healthier, but also that the meat may be healthier for consumers.

The next step is to define precise dosage of application of the product to forage and timing of feeding to cattle, as these parameters have been found to affect the effects. ●

References

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