Poison sedge and cyanogenesis

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DURING the afternoon of April 14 of this year, a flock of 800 sheep on a property in the Carnamah district was turned into an old stubble paddock which had been spelled for two months, after having carried the same sheep for the previous six months. The following day more than 200 sheep were found dead in the paddock, death having apparently occurred suddenly and without any struggling. The rapidity and severity of the losses, together with the lack of observed symptoms, suggested that the trouble had been due to a cyanogenetic plant (a plant capable of killing stock by the liberation of prussic acid after ingestion.)

The paddock in which these losses occurred is typical of the undulating sandplain country to the west of Carnamah. The natural vegetation is a stunted association of a great variety of species, with occasional taller shrubs and trees, the soil being of a light sandy nature. The depressions retain a certain amount of moisture during the summer months and usually carry a cover of green plants.

The majority of the dead sheep were found within a relatively small portion of the paddock, and when this area was inspected it was found that one depression contained a vigorous stand of a dark green, grass-like plant, the greater part of which had been eaten down to ground level. This was the so-called Poison Rush or Poison Sedge, a species of Schoenus, a plant which has long been looked on with suspicion, but has only recently been definitely established as a cyanogenetic plant.

DESCRIPTION

Poison Sedge is a tussocky, grass-like plant, growing in clumps of up to three inches in diameter at the base, with a vigorous fibrous rooting system. The
leaves are up to ten inches in length, dark glossy green in colour, smooth and flat, although usually rolled or folded. Each leaf is expanded into a broad open sheathing base, marked by numerous parallel veins and with a reddish colouration in the lower half. This is the character which can be most readily used in the vegetative condition for distinguishing between this plant and the true grasses, none of which has an open sheathing base similar to that of Poison Sedge, which is illustrated in Fig. 2.

Flowering culms (or stalks) develop from the crown during the winter months and attain a height of 15 to 18 inches. The culms are leafless, and bear a number of spikelets or clusters of flowers at their extremities. Each spikelet is surrounded by a number of reddish-brown bracts, similar in nature to the husk of oats, the apex of each of the outermost bracts being abruptly contracted into a leaf-like appendage. When the bracts fall from the culm after the seeds have matured, the characteristic zig-zag structure of the central axis of the spikelet is seen. A flowering plant is illustrated in Fig. 3.

NOT MANY SPECIES

The number of cyanogenetic plants in Western Australia is not very great, but most are capable of causing heavy stock losses. Unlike the native poison plants of the genera Gastrolobium and Oxylobium, cyanogenetic plants vary in toxicity, and under certain circumstances can be harmless. As a general rule it may be stated that a high prussic acid content can be associated with vigorous growth, and this is true of seasonal growth in either autumn or spring, or of rapid regeneration after mechanical injury or following fires.

No plants have been shown to contain free prussic acid, and so be capable of producing death of itself. The acid is always found in plant tissues combined with sugars in the form of glucosides, and in this form it is not poisonous. If, however, glucoside comes in contact with a substance known as an enzyme, which is capable of breaking it up into its constituent parts, free prussic acid is liberated, and death can be caused if there is sufficient of the acid present. It is essential that these two substances, glucoside and enzyme, should be present before prussic acid poisoning will occur. In some plants the two substances are always associated, so that when conditions are favourable to the formation of the glucoside, the enzyme is also formed and the plant immediately becomes
toxic. On the other hand, only one of the substances may be produced by the plant. Any such plant of itself would be harmless, but if two plants were eaten by an animal, one containing a glucoside, and the other an enzyme capable of reacting with that glucoside, the animal would be killed if there was sufficient of the poison in the first plant. It is interesting to note that some species of wattles are known to possess toxic properties if eaten in association with certain other species of plants.

**DENSITY IS IMPORTANT**

This distribution of glucoside and enzyme within the tissue of these plants at different stages of growth, as well as their distribution in nature, provides only one of the factors which are known to affect the ultimate toxicity of cyanogenetic plants. Another factor is the density of the stand of the toxic plant. In the paddock referred to above, if the plants of Poison Sedge had been scattered evenly over the whole of the 2,000 acres, instead of being concentrated in approximately one acre, the losses would probably have been negligible. Even if a vigorous stand of nutritious pasture species had been growing with the rush, it is probable that losses would have been less severe, as the animals would each have eaten less of the toxic plant.

The relative quantities of glucoside and enzyme within a plant is another important consideration. While it may be interesting to know how much prussic acid can be liberated within the plant by the enzyme present, it is far more important to know the total amount of poison that can be produced if additional active enzyme is contained in some other fodder. Thus in Native Fuchsia (Eremophila maculata F. Muell) Hurst, in “Poison Plants of N.S.W.,” reported that incubation of plant material for four hours liberated only 25% of the amount of prussic acid that could be liberated in the same time when the experiment was tried with additional enzyme. Such a plant, although it contains many times as much prussic acid as there is in sorghum, may actually prove less toxic in practice because the lack of enzyme in the tissue results in a slow liberation of the poison. With adequate enzyme intake in the fodder, it is thus the total glucoside content of the plant ingested, that would be the measure of its toxicity.

This concept of the speed of liberation of prussic acid is a fourth factor governing toxicity. Although the glucosides are readily broken down by
enzymes, the prussic acid so liberated may re-combine with other substances and once again become non-toxic. Thus in plants of low enzyme content, and providing no other source of enzyme is available, the rate of prussic acid liberated may be balanced by the rate at which it combines with other substances to form non-toxic compounds. Plants in which these reactions are balanced, would theoretically, be non-toxic. It is only when there is sufficient enzyme to ensure a rapid liberation of prussic acid, that the sudden onset of symptoms and severe losses so characteristic of prussic acid poisoning are seen.

The factors governing the poison potentiality of a plant are further complicated by the physical condition of the sheep themselves, particularly the question of hunger, while travelling stock are far more prone to the effects of poisonous plants than are paddock-grazing sheep. It is the inter-action of these numerous factors which causes the bewilderingly sudden onset of toxicity in cyanogenetic plants. The history of the Carnamah losses is typical of prussic acid poisoning: the sheep had been grazed for some time in the paddock, and then sudden severe losses occurred.

It is the sudden flush of potential toxicity which constitutes the menace of this type of plant, as where losses occur they are usually heavy. It is fortunate that, heavy though losses from these plants may be, the plants themselves are not as important economically as are the species of Gastrolobium and Oxylobium, but must always, however, remain a potential menace to the pastoral economy of this State.

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