

SOME TAXONOMIC, AGRONOMIC AND ANIMAL HEALTH ASPECTS
OF *TRIBULUS*

C.A. Bourke
Agricultural Research and Veterinary Centre, Forest Road
Orange N.S.W. 2800

Summary. The taxonomy of *Tribulus* spp. in Australia is reviewed. The distribution and agronomic characteristics of the major *Tribulus* spp. in N.S.W. are discussed. The factors that regulate the *Tribulus* content of pastures are emphasised. The diseases of sheep associated with grazing *Tribulus* dominant pastures are summarised.

INTRODUCTION

The taxonomy and agronomy of the plant genus *Tribulus* are poorly documented both nationally and internationally. The specific epithet *terrestris* has been loosely applied to different *Tribulus* spp. and sub species in herbarium collections in Australia and one would suspect elsewhere. In 1981, I started investigating the diseases of sheep associated with the ingestion of *T. terrestris*, and in this regard the correct identification of species as well as a proper understanding of the agronomic characteristics of the genus became important. Unfortunately, when I turned to the botanical literature for assistance, accurate and useful information was difficult to find. This paper presents a synopsis of my observations and investigations into this group of weeds, with particular reference to the situation in N.S.W.

TAXONOMY

Tribulus belongs to the family Zygophyllaceae. In Australia this family is represented by the genera *Tribulus*, *Tribulopsis*, *Nitraria*, *Peganum* and *Zygophyllum*. The American genera *Kallstroemia* and *Kelleronia*, along with *Tribulopsis*, have at one time or another been considered synonyms of *Tribulus* (13). *Kallstroemia* spp. are listed under Queensland flowering plants (6) but according to Porter, this is incorrect and these species are either *Tribulus* or *Tribulopsis* (13).

The most dominant *Tribulus* spp. in Australia appears to be *T. terrestris*, however botanical specimens so called vary greatly in their morphological characteristics. Squires (14, 15) for example, has subdivided the species into *T. terrestris* (introduced) found in southern Australia and *T. terrestris* (native) found in central and northern Australia. Within N.S.W. the distribution of *T. terrestris* (introduced), as illustrated by Squires is incorrect, because the plant form dominant in northern N.S.W. has now been identified at the National Herbarium Canberra as a separate species *T. micrococcus* (Domin) (H. Eichler pers. comm., 1984). Jacobs and Pickard (10) have incorrectly categorised *T. terrestris* in N.S.W. into three forms; caltrop, spineless caltrop and yellow vine. The so called yellow vine form is *T. micrococcus*. The Royal Botanic Gardens in Sydney have accepted that the *Tribulus* taxa in N.S.W. are in need of review (K. Wilson, pers. comm., 1984).

In Australia the following species have been all at times incorrectly identified as *T. terrestris*: *T. astrocarpus*, *T. cistoides*, *T. hystrix*, *T. hirsutus*, *T. macrocarpus*, *T. micrococcus*, *T. minutus*, and *T. occidentalis*. The following species have recently been transferred to the genus *Tribulopsis*: *T. affinis*, *T. angustifolia*, *T. astrocarpa*, *T. bicolour*, *T. curvicarpa*, *T. pentandra* and *T. platyptera* (L. Johnson, pers. comm., 1983). Common names applied to *T. terrestris* are very confusing, and include: caltrop, cathead,

cats-head, bindii, dubbleji, puncture vine, goat head, bulls head, and yellow vine.

T. terrestris (introduced), the dominant type in southern Australia, probably arrived prior to 1895 as a contaminant of seed from the Mediterranean area, South Africa or California (11). It was observed to be spreading throughout N.S.W. by 1910 (1). Both Maiden (11) and Anderson (1) incorrectly referred to the plant as a native of the colony. The introduction of rubber tyred vehicles, especially tractors, in the late 1920's and early 1930's resulted in the subsequent rapid spread of this weed in cultivation paddocks and waste lands. *T. micrococcus* (previously *T. terrestris* "yellow vine" form) is a native of Australia, it has not been recorded elsewhere in the world and can be observed to grow from as far south as Merriwa in central-east N.S.W. to as far north as Charters Towers in central-north Queensland. It was first described in 1926 (8).

TRIBULUS SPECIES IN N.S.W.

The major species present is *T. terrestris* (introduced). It is usually found growing as a prostrate herb with a small yellow flower similar in size to the fruits which are invariably spined. Under excellent growing conditions and high plant densities, this normally prostrate species can achieve a height of 30 cm. Large infestations of *T. micrococcus* are also to be found. This species is more upright and has a yellow flower approximately four times the size of its fruits, which are invariably spineless. Relatively insignificant communities of *T. terrestris* (native), *T. minutus* and *T. occidentalis* (sometimes listed as *T. hystrix*) are also to be found.

T. terrestris (introduced) is most commonly found in the central-west slopes and the south-west slopes but grows to a limited extent in all districts with the exception of the coastal plains and the higher tablelands. *T. micrococcus* is confined to central and northern areas of the state, and is particularly prolific in the north west slopes. It is absent from tablelands areas. *T. terrestris* native, *T. minutus* and *T. occidentalis* occur as small scattered communities in the western districts of the state.

T. terrestris (introduced) is most prolific in the area bounded by Wellington, Baradine, Coolah and Trangie. The main reasons for the remarkably successful growth of *T. terrestris* in this region are: summer-dominant rainfall, high summer temperatures high light intensities, heavy soils of good fertility and the type of agriculture that predominates (winter cereals and sheep). The area of optimal growth for *T. micrococcus* extends from Coonamble, and Quirindi northwards to the Queensland border. This area is adjacent to the southern limit of the summer-dominant rainfall zone. The success of this plant has been favoured by the same factors listed for *T. terrestris* introduced, however *T. micrococcus* appears to have an even higher requirement for temperature and light intensity (C. Bourke unpublished data).

FACTORS REGULATING TRIBULUS DOMINANCE

Both *T. terrestris* (introduced) and *T. micrococcus* are summer growing annuals that display high drought tolerance. They are both opportunistic weeds of cultivation paddocks and waste lands. Whereas *T. terrestris* introduced tends to be associated with Mediterranean type climates, *T. micrococcus* occurs in more sub tropical locations. Neither species will tolerate shading and consequently they only achieve dominance when other vegetation is removed by summer fallowing, drought, overgrazing, or use of broadspectrum herbicides. In these situations *Tribulus* dominance is most rapidly achieved when the

following conditions occur: a brief but heavy fall of rain, plenty of sunshine, high temperatures, and a heavy and fertile soil with a large seed reservoir.

The ideal situation for *Tribulus* dominance occurs on farms in summer rainfall dominant areas, where winter cropping, rather than summer cropping, is practised, where shorter winter pasture species such as ryegrass and clover rather than taller summer species such as rhodes grass and lucerne are grown, and where sheep rather than cattle are the main livestock enterprise. Because *Tribulus* spp. develop rapidly (e.g. germination to fruit set can occur in 21 days), they can quickly establish a large seed reservoir in the soil. Much of this seed is dormant and remains viable for many years. *Tribulus* spp. also use limited soil moisture very efficiently. A single rain storm of 25 mm during a drought period is sufficient to germinate and maintain a *Tribulus* plant community for over eight weeks (C. Bourke unpublished data).

A *Tribulus* dominant community rapidly deteriorates when excess moisture inhibits its growth and allows taller plant species to establish and quickly shade the lower growing *Tribulus*. *Tribulus* communities will also decline during periods of cool cloudy weather and are particularly sensitive to frosts. Bare, drought-stricken cultivation paddocks offer an ideal environment for *Tribulus* growth, provided the weather remains sunny and hot and there are only occasional thunderstorms spaced several weeks apart. This situation occurs approximately every 10 years in the Dubbo, Coonabarabran and Narrabri districts of central and northern N.S.W. and at these times almost pure stands of *Tribulus* can be seen. These infestations cover thousands of hectares in only a few weeks and maintain their dominance for several months. This situation does not seem to occur elsewhere, either in Australia or overseas. In South Africa, where several species are relatively common, *Tribulus* is only reported as a significant weed in the Karoo district, a region with a climate and land use similar to the far west of N.S.W. The Orange Free State is the only region in South Africa where summer-rainfall dominance, high temperatures, high light intensities, arable soils of good fertility, and winter cereals and sheep enterprises predominate. *Tribulus* has not yet been reported as a problem weed in this region.

In N.S.W. *Tribulus* growth is only significant between November and April. During this period dominance will occur for 6 to 12 weeks at a time, but over the whole period two or three germinations may occur. January to April is the most reliable period for growth of *Tribulus*. During the very severe drought between 1980 and 1983, many farmers in central and north-western N.S.W. observed *Tribulus* to be the most abundant genus from October through to May.

SHEEP DISEASES ASSOCIATED WITH *TRIBULUS*

Only in Australia and South Africa is *Tribulus* a significant cause of deaths in animals (usually sheep). However, some stock losses have been reported in North America, the Mediterranean and Arabia. *Tribulus* spp. accumulate nitrate (9) and consequently when hungry sheep graze pastures densely infested with *Tribulus* spp., and gorge themselves on the plant, many will die within the first 12 to 24 hours. After this period, most animals can detoxify the nitrate and thus continue to graze the plant in safety.

T. terrestris contains substances which are potentially toxic to the liver and as a consequence death from primary liver failure can occasionally occur (C. Bourke, unpublished data). The more common problem is a disease called "yellow big head" or "geeldikkop" (2, 9), which involves liver damage and photosensitisation. A combination of the ingestion of a toxin from the

Tribulus and the ingestion of a toxin produced by a pasture litter fungus called *Pithomyces chartarum*, results in the liver damage. The affected animals become jaundiced, then the action of direct sunlight on the wool free skin of the face results in swelling of the face and ears. A number of affected sheep will die. In South Africa this disease is a major problem of sheep on drier rangeland areas such as the Karoo districts. In N.S.W. the problem does not seem to be as great, and is largely confined to the southern and lower central districts of the state, rather than the upper central and north-west districts where *Tribulus* is often more abundant.

Perhaps the most interesting sheep diseases associated with grazing *Tribulus* pastures are the two locomotor disorders, chronic *Tribulus* staggers (3) and transient *Tribulus* ataxia (4). Both of these nervous disorders are only recorded in N.S.W. However, in America two similar weeds *Kallstroemia hirsutissima* (hairy caltrop) and *Kallstroemia parviflora* (warty caltrop), have been associated with locomotor disorders in sheep, cattle and goats (12, 7).

Chronic *Tribulus* staggers occurs in the Coonabarabran and Dubbo districts of N.S.W. It develops in sheep after they have been grazing pastures heavily dominated by *T. terrestris*. The disease causes a chronically progressive, asymmetrical, and irreversible weakness of the limbs. Approximately 20,000 sheep on 150 farms died as a result of this disease during and after the 1981-1983 drought. The disease has recently been shown to be a nervous disorder that affects the same area of the brain as that involved in Parkinson's disease in humans (5). Transient *Tribulus* ataxia occurs in the Narrabri district of N.S.W. It develops in sheep after they have been grazing pastures heavily dominated by *T. micrococcus*. The disease causes a fairly rapidly progressive, symmetrical, reversible, ataxia of the limbs. Fortunately, most affected sheep return to normal within several weeks of being moved off the *Tribulus* pasture.

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