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Tribulus: Caltrop and yellow vine

Weed Management Unit

Introduction

Tribulus weed species are summer growing annuals that occur throughout mainland Australia and have high drought tolerance.

Two troublesome species occur in New South Wales (NSW): an introduced species with a small yellow flower and spiny fruit, called caltrop (*Tribulus terrestris*), and a native species with a larger yellow flower and a spineless fruit, called yellow vine (*Tribulus micrococcus*).

Both species are opportunistic weeds of cultivation, waste lands and degraded pastures.

Under certain conditions, grazing of *Tribulus* has been associated with nitrate poisoning, photosensitisation and sheep staggers. Spines on caltrop fruit damage the feet of livestock, causing lameness, and caltrop fruit can become embedded in sheep fleece, lowering its value and causing discomfort to shearers.

Caltrop is also a weed of urban areas and is a nuisance on footpaths and playing fields. It is not a declared noxious weed in NSW.

Distribution

Caltrop is now found worldwide, particularly in areas with a Mediterranean climate. It is listed as a weed in 37 countries. Caltrop is thought to have been accidentally introduced before 1896 as a contaminant of seed from the Mediterranean area, South Africa or California. The introduction of rubber-tyred vehicles in the late 1920s and early 1930s caused the rapid spread of this weed.

Caltrop occurs in all Australian states except Tasmania. In NSW it is most commonly found in the central west slopes and north-west slopes. These regions of NSW provide ideal growing conditions for caltrop. They have adequate summer rainfall, high summer temperatures and sunlight intensity, and fertile soils.

Yellow vine is a native of Australia – it has not been recorded elsewhere in the world. It was first described in 1926. Yellow vine is confined to central and northern areas of NSW, and is particularly common on clay soils in the north-west slopes. The success of yellow vine has been favoured by the same factors listed for caltrop; however yellow vine appears to have higher requirements for temperature and light intensity.

Small scattered communities of the *Tribulus* species *T. minutus* and *T. eichlerianus* are also found in western NSW. These species are not considered to be troublesome.

Description

Caltrop is a prostrate annual herb with stems spreading out for up to 2 m from a woody taproot.

- **Leaves** consist of 4–8 pairs of opposite oblong leaflets. The upper surface is dark green, while the lower surface is covered with hairs, giving the surface a silvery appearance.

Figure 1. Caltrop has a small yellow flower and a woody burr with sharp rigid spines. JR Hosking

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- **Flowers** are only small, 8–15 mm in diameter and bright yellow in colour and have 5 petals, 3–3.5 mm long. The flowers only last one day. Caltrop flowers from spring to autumn (Figures 1 and 3).
- **Fruit** consists of a woody burr with sharp rigid spines, which splits into segments when ripe (Figure 1). Each segment has four long hard spines, 4–5.5 mm long; two spines are long and two shorter.

Yellow vine is a prostrate to partially erect annual herb with stems sometimes exceeding 1 m in length.

- **Leaves** have 3–7 pairs of oblong-shaped leaflets. These leaves appear to shine and have hairs on the leaf margins.
- **Flowers** are pale yellow, 11–25 mm in diameter and have 5 petals, 5–9 mm long. Yellow vine flowers from spring to autumn (Figures 2 and 3).
- **Fruit** is a round burr, which splits into segments when ripe. Each segment has two short spines, 2–2.5 mm long, or no spines at all (see Figure 2). This is in contrast to the fruit segments of caltrop that have four spines.

Life cycle

Caltrop and yellow vine are annual plants which germinate after rainfall in late spring and summer when the maximum air temperature reaches 24°–27°C. There is a succession of germinations throughout the summer following each rainfall event.

Plant growth is rapid and a deep root system develops in a few weeks. With the characteristic low water requirement of caltrop and yellow vine, these species survive prolonged dry conditions.

Flowering is rapid, with the first flowers appearing within three weeks and the first fruit within five to six weeks of germination. Flowering may continue for several months until the first frosts in autumn/early winter, when plants die.

Fruit are produced continually throughout summer and autumn. More than 1000 seeds can be produced by a single plant and seed can remain viable for many years.

Caltrop is able to regenerate from tap root material if frosted off or if shoot growth is removed by cultivation, chipping or herbicide damage.

Figure 2. Yellow vine has a large yellow flower and a round burr. GR Sainty

Figure 3. Caltrop (top) and yellow vine (bottom). S Johnson

Dispersal

Caltrop and yellow vine are spread by seeds which are contained within the fruit. Caltrop fruit are well equipped for dispersal: whichever way the fruit lies on the ground, one of the spines always points upwards. Fruit readily attach to the feet of animals, vehicle tyres, rubber-soled shoes and almost any object that is placed on it. Fruit also become embedded in sheep fleece.

Caltrop and yellow vine are prostrate plants, allowing the plant to expose the maximum number of fruits for dispersal.

Livestock toxicity

Tribulus spp. often provide the first green pick after summer rains and such growth is appealing to grazing stock. However, under certain conditions, grazing of caltrop and yellow vine has been associated with sheep staggers, nitrate poisoning and photosensitisation.

Staggers

Caltrop and yellow vine cause similar, but slightly different, nervous disorders.

Chronic *Tribulus* staggers develops in sheep after they have been grazing pastures dominated by caltrop. Transient *Tribulus* ataxia (loss of muscle coordination in the hind legs) develops in sheep after they have been grazing pastures dominated by yellow vine.

Both of these nervous disorders are recorded only in NSW.

Chronic *Tribulus* staggers

The ingestion of large amounts of caltrop over many months can result in a progressive and irreversible weakness in the hind legs of sheep. A unique aspect of this limb weakness is that it is much more prominent on one side of the body (Figure 4). This makes the animal lean to one side in the hindquarters and consequently, to walk or run diagonally rather than straight ahead.

Eventually limb weakness extends to the fore limbs, and this makes it increasingly difficult for the sheep to get up. They spend more time lying down and eventually die of thirst, flystrike or pneumonia. The disease progresses regardless of good nursing and hand feeding and the outcome is always fatal.

Signs of poisoning may not develop until several months after sheep have stopped grazing caltrop. The average duration of the disease is 8 months but varies from 1–15 months.

This disease only occurs in the central west districts of NSW.

Transient *Tribulus* ataxia

When sheep graze large amounts of yellow vine over several months, a slightly different hind leg weakness may develop to that caused by caltrop. Affected sheep are affected in both hind legs equally and eventually the fore legs will also be affected. The most obvious symptom of the disease is that sheep are unable to support their weight with their hind legs; as such sheep may appear to 'crouch down' in the hindquarters and walk by dragging their hind legs (Figure 5). The forelimbs are eventually affected and sheep will lie down and die of thirst or misadventure.

Unlike chronic *Tribulus* staggers, this syndrome is reversible and affected sheep will return to normal within 3–6 weeks of being moved from yellow vine infested pastures. However, a number of affected sheep will die as a result of secondary complications, such as thirst, flystrike or pneumonia. This disease only occurs in the north-western districts of NSW.

There are no proven methods of preventing chronic *Tribulus* staggers or transient *Tribulus* ataxia. However, as cattle do not seem to suffer from staggers, graze cattle in preference to sheep on *Tribulus* dominant paddocks. If it is necessary to put sheep on *Tribulus* infested paddocks, use Merino sheep to graze these pastures rather than crossbreds. Crossbreds tend to graze *Tribulus* plants more readily than Merinos, hence poisoning is more common in these breeds. There may also be some benefit in diluting the daily intake of these plants by feeding supplementary grain or hay to livestock when grazing caltrop or yellow vine dominant pastures.

Figure 4. The back legs of sheep with chronic Tribulus *staggers sway to one side. CA Bourke*

Figure 5. A typical case of transient Tribulus ataxia*. Note the crouched appearance of the hindquarters. CA Bourke*

Nitrate poisoning

Nitrate poisoning is usually seen only when hungry sheep or cattle are put into a paddock that has an abundant growth of caltrop or yellow vine. Hungry stock tend to gorge themselves on the fresh lush growth but their stomachs cannot quickly adapt to the large amounts of nitrate that may be present in the plants they have consumed. As a result, many animals may die within 12–48 hours of being placed in the paddock.

After this period, surviving animals can detoxify the nitrate and thus continue to graze the plant in safety.

To avoid nitrate poisoning do not put hungry stock, such as those that have been trucked long distances or stock that have been held for long periods in stock yards, straight into paddocks with large amounts of caltrop or yellow vine.

Photosensitisation

The photosensitisation effect of caltrop is commonly referred to as 'yellow big head'.

The disease involves liver damage and, as a result, photosensitisation. It occurs if a toxin from caltrop and possibly a toxin from a pasture litter fungus are present at the same time.

Due to the liver damage, a light-sensitive compound called phylloerythrin (which derives from metabolised chlorophyll, the green pigment in plants) cannot be excreted and it builds up in the bloodstream. When sufficient quantities of phylloerythrin enter the blood vessels in the skin of an animal, sunlight transforms the phylloerythrin into a toxin that severely damages the skin, causing the photosensitisation effect.

The disease appears as swelling of the face and ears, with a yellowish discolouration of the inner eyelids and gums. Affected animals will be listless and off their feed and many may die.

Photosensitisation due to the ingestion of caltrop occurs only spasmodically, and is most typically seen in association with a recent rainfall event. In NSW the problem is largely confined to the southern and lower central districts of the state, rather than the upper central and north-western districts where caltrop is often more abundant.

Animals suffering from photosensitisation should be removed from caltrop-infested pastures and held in full shade for at least 7–10 days. During this period, stock should be provided with water and cereal hay or lower quality pasture hay. After this period, stock can be returned to direct sunlight. Affected animals can also be treated with corticosteroid drugs administered by a veterinarian, which will reduce the swelling and inflammation associated with the disease.

Control and management

The most effective means of controlling caltrop and yellow vine is through a variety of methods, such as pasture or crop competition. Chemical and cultivation methods are also used to control these weeds.

Prevention of spread

Preventing the spread of caltrop and yellow vine is the best control measure. Learn to identify these weeds; regularly check for them in late spring and summer. If found, act promptly to remove them.

Caltrop and yellow vine spread only through the movement of seed, so methods which prevent seed moving to uninfested areas should be adopted.

- If you purchase livestock from areas contaminated with caltrop or yellow vine, limit their access to paddocks where a good perennial pasture exists. Monitor these paddocks and treat any infestations.
- If you have paddocks on your property infested with caltrop or yellow vine, minimise stock movements from infested to clean paddocks.
- Clean machinery and vehicles before moving out of areas infested with caltrop or yellow vine.

Pasture and crop competition

Caltrop and yellow vine are vulnerable to competition; consequently these weeds only achieve dominance when other vegetation is removed by summer fallowing, drought or overgrazing. The extensive areas of winter cereal crops in central and northern NSW predisposes large areas to caltrop and yellow vine infestation, especially during dry summer periods. Competition from perennial pasture species or annual summer crops can reduce the establishment of caltrop and yellow vine.

To improve the competitive nature of perennial pastures against caltrop and yellow vine, fertilise regularly, control pests and time grazing appropriately. For example, every 2–3 years for temperate perennial pastures defer grazing in late spring for 10–12 weeks or significantly reduce the grazing pressure. This will increase the bulk of the pasture, increase ground cover and therefore increase the competition against the summer growing caltrop and yellow vine. However, in late summer graze the pasture to remove dry residues before autumn. This will assist clover germination in early to mid-autumn.

For tropical perennial pastures during summer, some grazing will be necessary to prevent the pastures from becoming rank, but retain at least 5 cm leaf height on the plants to maintain the competitive nature of these pastures against caltrop and yellow vine.

Summer crops are highly competitive and provide good competition against the establishment of caltrop and yellow vine throughout the summer period. Some key management strategies that will enhance the competitive nature of summer crops include the following.

- Choose crop species and varieties that are best suited to your climate and soil type.

- Ensure good agronomic practices such as appropriate sowing time and depth, adequate fertility and moisture at sowing.
- Use high sowing rates to achieve full ground cover quickly.
- Use narrow row spaces to provide full ground cover much quicker than wide row spaces.
- Direct drill to minimise disturbance.
- Band nitrogen in crops. It will be more directly available to the crop than to the weeds.

Chemical control

Correct identification of the *Tribulus* species present is important to ensure effective herbicide application and to avoid legal complications with off-label applications.

Today there is a wide range of herbicides available for controlling caltrop and yellow vine.

However, when considering spraying as a control measure it is important to remember that there is a succession of germinations of both these weeds throughout the summer, and plant growth is rapid (the first fruit can emerge in 5–6 weeks). Therefore, more than one spray application may be necessary (particularly if a residual chemical is not used) and the timing of spray applications is critical to ensure that the majority of the weeds have been sprayed before seed set occurs. Using spraying as the only control method can be impractical and it is usually better to combine spraying with other means of control.

Important considerations when deciding which chemical to use and when to spray include:

- Chemical sensitivities of your crop or pasture species as well as the surrounding crops, pastures and environment. Be aware that the sensitivity of some crops and pastures to herbicides may change with plant growth stage.
- Residual nature of the chemical.
- Spray caltrop and yellow vine when the plants are actively growing. Stresses such as drought, waterlogging and extremely hot or cold weather may reduce the effectiveness of spraying.
- Spray small, vigorously growing plants. These are easiest to kill, require less chemical, and early control avoids major competition with crops and pastures.

Advice on chemicals can be obtained from your local agribusiness supplier, your local agronomist and the publications *Weed Control in Winter Crops* and *Weed Control in Lucerne and Pastures*, both available from Industry & Investment NSW.

Cultivation

Cultivation will kill caltrop and yellow vine seedlings; however, due to the successive germinations of both these weeds throughout the summer, cultivation alone can be impractical and it is usually better to combine cultivation with other means of control.

Patches of caltrop and yellow vine should be cultivated before the plants flower. Due to the rapid growth of these weeds, cultivation should not be delayed. If fruit are produced before the plant is controlled, the entire plant should be removed carefully by hand and burnt.

Biological control

There is some potential for the control of caltrop and yellow vine using biological control agents. However, potential biological control agents that have been effective overseas may not be permitted entry into Australia as they could potentially damage the native species of *Tribulus*.

Nevertheless, in Australia the seeds of caltrop and yellow vine are sometimes attacked by the larvae of a small native moth (*Ephysteris subdiminutella ferritincta*). The level of infestations can be quite high, particularly late in the season, but overall the impact of the insect is low.

There is also a native mite (*Eriophyes tribuli*), which causes hair-like growth on stems and leaves (Figure 6). If present on caltrop or yellow vine plants early enough this mite can prevent flowering, and therefore seed production.

Figure 6. Damage to yellow vine by the native moth Eriophyes tribuli*. Note the hair-like growth on the plant. JR Hosking*

References

Naughton M and Bourke C 2005. *Caltrop and yellow vine*, Agfact P7.6.59, First edition.

Bourke, CA 1983, 'Hepatopathy in sheep associated with *Tribulus terrestris*', *Australian Veterinary Journal*, vol. 60, pp. 189.

Bourke, CA 1984, 'Staggers in sheep associated with the ingestion of *Tribulus terrestris*', *Australian Veterinary Journal*, vol. 61, pp. 360-363.

Bourke, CA & MacFarlane, JA 1985, 'A transient ataxia of sheep associated with the ingestion of *Tribulus micrococcus* (yellow vine)', *Australian Veterinary Journal*, vol. 62, pp. 282.

Bourke, CA 1987, 'Some taxonomic, agronomic and animal health aspects of *Tribulus*', *Proceedings of the eighth Australian weeds conference*, Weed Society of New South Wales, Sydney, pp. 182-185.

Bourke, CA, Stevens, GR & Carrigan, MJ 1992, 'Locomotor effects in sheep of alkaloids identified in Australian *Tribulus terrestris*', *Australian Veterinary Journal*, vol. 69, pp. 163-165.

Bourke, CA 1995, 'The clinical differentiation of nervous and muscular locomotor disorders of sheep in Australia', *Australian Veterinary Journal*, vol. 72, pp. 228-234.

Parsons, WT & Cuthbertson, EG 2001, *Noxious weeds of Australia*, 2nd ed, CSIRO Publishing.

Squires, VR 1979, 'The biology of Australian weeds 1. *Tribulus terrestris* L', *Journal of the Australian Institute of Agricultural Science*, vol. 45, pp. 75-82.

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