Effect of sheep mastication and digestion on the transmission and viability of small-flowered mallow (Malva parviflora L.) seeds

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Summary Malva parviflora L. is increasingly becoming a problem in Australian farming systems, both in cropping and livestock production. There may be a potential to utilise livestock for the control of M. parviflora in Australia, however, there is no knowledge of the digestion and transmission of seeds by sheep.

Two experiments were carried out, the first investigating the effects of rumen digestion on M. parviflora viability and the second investigating mastication and digestion effects on the transmission and germinability of the seed. Results showed that soft seed, which was able to imbibe water, was totally destroyed as a result of rumen digestion. However, the seed coat of the hard non-imbibing seed enabled it to survive rumen digestion with no apparent loss of viability. The passage of seed followed a normal trend with a peak at 36 hours after digestion. Little seed was excreted prior to 12 hours or after 120 hours following consumption.

There may be a potential to manage the weed using livestock as long as the seed coat is soft and able to imbibe water. However, if the seed coat is fully developed and able to prevent imbibition, livestock may act as a vector to spread the weed around the farming system.

Keywords Malva parviflora, sheep, mallow, seed.

INTRODUCTION

Little is known about small-flowered mallow, Malva parviflora L. (also called ‘marshmallow’ in Western Australia). Throughout Australia it is a weed of wasteland, crops and pastures (Auld and Medd 1992). Small-flowered mallow can be difficult to control chemically and changing farming practices, such as minimum tillage, have facilitated its spread. Malva parviflora has already increased in distribution and density in Western Australia (WA) over the past few years and this trend is likely to continue unless suitable control measures are identified and implemented.

In Australia there is evidence that consumption of very large quantities of M. parviflora (1.4–5.5 kg day⁻¹) in addition to hard driving can cause ‘staggers’ in sheep, horses and cattle, a potentially fatal condition (Dodd and Henry 1922, Hurst 1942, Everist 1974). It is therefore important to control M. parviflora, not only to reduce weed-crop competition, but also to reduce the negative consequences on livestock health.

Livestock have been used to control weeds in the past, however animal excrement may disseminate weed seeds. Many studies have found that seed survival with passage through animals is related to the degree of hardseededness in addition to seed size (Simao Neto and Jones 1987, Simao Neto et al. 1987, Norton et al. 1989, Gardener et al. 1993a,b, Squella and Carter 1996). It is likely therefore that the hardseededness of Malva species as well as its small size would allow a significant proportion of seeds to survive digestion. There is evidence that viable M. parviflora can be transmitted through birds and horses (St. John-Sweeting and Morris 1990), however there is no information on the transmission of M. parviflora through sheep. Sheep are an important part of Australian farming enterprises and are most likely to consume the weed.

MATERIALS AND METHODS

In vivo rumen digestion Using two fistulated sheep, seeds were placed into the rumen for 12, 24, 36 and 48 hours. Two seed treatments were used: hard and soft. Hard seeds were those which had their seed coat intact and were not able to imbibe. Soft seeds had their seed coat cut using rabbit-toothed tweezers to enable water imbibition. After removal from the rumen, germination and viability tests were carried out on the seeds. This involved placing seeds on agar for two weeks in a controlled temperature incubator (25/15°C; 12 h light/12 h dark). After this period of time, hard seeds were nicked and kept on agar for a further two weeks. Ungerminated seeds were placed into a 1% tetrazolium solution for 18 hours at 30°C to determine seed viability.

Seed transmission Hard M. parviflora seeds (125 g, 70,000 seeds) were fed to three harnessed sheep. Faeces were collected for 144 hours following feeding with the bag changed at 6, 12, 24, 36, 48, 72, 96, 120 and 144 hours after feeding. Total seed content of faeces was determined using a 100 g subsample. Seeds were removed from faeces using the wet sieving method (Jones and Bunch 1988). Recovered seeds
were counted and then placed on agar to ascertain germinability and viability as described above.

RESULTS

In vivo rumen digestion The initial viability for both hard and soft seed treatments was 99%. After digestion for only 12 hours, viability dropped to just 2% for soft seeds (Figure 1). No viable soft seeds were found in the other sampling times. For hard seeds, viability remained at least 95% throughout the entire rumen digestion period.

Seed transmission Only one seed was excreted at both 6 and 12 hours after *M. parviflora* consumption (Figure 2). A peak excretion plateau occurred between 36 and 72 hours. Seed recovery followed an exponential pattern to reach the plateau and to descend from the plateau, with negligible seed being recovered after 144 hours. Over 95% of seed for each sample was viable and able to germinate after cutting the seed coat to allow imbibition.

DISCUSSION

Viable *Malva parviflora* seed can be transmitted through the digestive tract of sheep. The hard seed coat of *M. parviflora* enables it to survive rumen digestion and prevents the death of the embryo. It is likely also that the small seed size allows it to be transmitted through the digestive system of sheep and helps to minimise the impact of sheep mastication and rumination.

These experiments show that it is possible to use sheep as a form of biological control of the weed, provided that the seed coat has not formed thus allowing imbibition to occur. However, if the seed coat has formed fully thus preventing imbibition, sheep will act as a vector for the weed and spread it across the farming system. The inbreeding nature of the *Malva* species (Kristofferson 1926) means that only one viable germinating seed is needed to propagate a new population.

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REFERENCES


