Biology of Globe Chamomile (*Oncosiphon piluliferum* (L.f.) Källersjö)

Alexandra Douglas[1] and David F. Nicholson[2]
[1]Department of Primary Industries and Regional Development, 444 Albany Hwy, Albany, Western Australia 6330, Australia
[2]Department of Primary Industries and Regional Development, 75 York Rd, Northam, Western Australia 6401, Australia
(alex.douglas@dpird.wa.gov.au)

Summary A number of experiments were conducted to investigate triggers for germination and seed bank persistence of Globe Chamomile (*Oncosiphon piluliferum*) in Western Australia.

Globe Chamomile germinated between 10°C and 25°C and not at other temperatures tested. It is unlikely that Globe Chamomile will germinate in summer. Globe Chamomile seed survives well when buried at 2-10 cm, and darkness inhibits germination under laboratory conditions.

Seed has been shown to survive in the soil for several years if buried. There may be implications for summer fallow management if cultivation is used and the use of soil inversion at crop establishment as these practices will bury seed to depths where it can remain viable.

Keywords *Oncosiphon Spp*, Globe Chamomile, Calomba Daisy, Matricaria, germination, seed bank.

INTRODUCTION

Oncosiphon Källersjö (Asteraceae: Anthemideae) is a genus of aromatic herbs that are endemic to the Cape region of southern Africa (Kolokoto and Magee 2018). Two species, *Oncosiphon suffruticosum* (L.) Källersjö and *Oncosiphon piluliferum* (L.f.) Källersjö, have been reported as invasive in Australia (Western Australia and South Australia) (ALA 2021) and in California and Arizona in the USA (Hedrick and McDonald 2020).

Species of *Oncosiphon* are commonly referred to as stinkruid in Afrikaans (meaning stink-weed) and stinknet in the US. In Australia *O. suffruticosum* is referred to as Calomba Daisy and *O. piluliferum* as Globe Chamomile. In the Western Australian grain belt they are referred to collectively as Matricaria.

The two species of Matricaria in WA can be distinguished by their flower heads. Columba Daisy (more 'club' shaped flower heads) and Globe Chamomile (rounder, globe shaped flower heads). Both species of Matricaria are erect annual herbs with bright yellow flowers and look very similar until the flowers start to form. They both have a strong unpleasant smell, form dense stands and are considered unpalatable to grazing livestock (although not known to be toxic) (Parsons and Cuthbertson 1992). Only one species, Globe Chamomile, has been used in these studies as it is the most common in the region.

Since appearing in the eastern grain belt of Western Australia in the late 1960s, Matricaria has spread widely in that region and is now a serious weed (Dodd 1990). Matricaria is spreading into the neighbouring Northern agricultural region where the farming systems and seasonal conditions are similar and is considered an emerging threat (Michael et al 2011).

This research aimed to identify triggers for germination and potential longevity of the seed bank of Globe Chamomile (extrapolated to Calomba Daisy), as an aid to management plans in cereal cropping systems.

MATERIALS AND METHODS

Seeds from four Globe Chamomile populations were subjected to various conditions and the effect on germination assessed. All four populations had been collected during the same week in December 2017, with three of the collected populations growing within 25 km of each other north of Merredin (31.44°S, 118.27°E) and the fourth population located in Mukinbudin (30.93°S, 118.34°E). Two populations were collected from roadsides, Knungajin-Merredin Rd (31.46°S, 118.27°E) and Nangeenan Rd (31.49°S, 118.16°E), and the remaining two collected within paddocks adjacent to trial areas.

Temperature on germination Five temperatures were assessed: constant 5°C, 15°C, 25°C, 35°C and 45°C, for a two week period. Three replicates with 50 seeds each were placed in petri dishes with filter paper and distilled water. The test was conducted in an incubation cabinet with an alternating 12 hour dark/light cycle. The test at 5°C was conducted in a refrigerator.

Light or dark conditions and scarification Further samples of seed from the populations above, were subjected to light and dark conditions (petri dishes wrapped in aluminum foil) and scarification (the seed was rubbed gently between two rubber mats for 10 seconds, before being placed in petri dishes).

Samples were placed in cabinets with a 10/20°C 12 hour dark/light cycle, for two weeks.

Depth of burial over time A field trial was established at Northam (31.65°S, 116.69°E) to determine the effect of depth of seed burial on the persistence of Globe Chamomile. Three new Globe Chamomile populations were sampled for this experiment; Nangeenan/Connell (31.45°S, 118.15°E), Nangeenan/Fitzpatrick (31.42°S, 118.14°E) and Nokanning (31.37°S, 118.18°E). Fifty seeds from each of the three populations were placed in nylon bags and buried at different depths (0, 2, and 10 cm) in June 2017. Bags were collected in September and December 2017, June 2018, June 2019 and a final collection, at 36 months, June 2020.

Following collection, seeds were removed from the bags and placed in petri dishes with filter paper, distilled water and gibberellic acid (0.1g/1L solution). Globe Chamomile seeds were placed in an incubator and subjected to a 12 hour, 10/20°C dark/light temperature regime. Dishes were checked 10 days after the test commenced, germinated seedlings were counted and removed and the test continued for a further 10 days, when the final count was made. The percentage germination was calculated from total number of seeds initially placed in the bags at the time of burial.

RESULTS AND DISCUSSION

Temperature on germination Globe Chamomile germinated at 15 and 25 degrees only. No germinations were recorded for the samples kept at 5°C, 35°C and 45°C (Table 1). Matricaria are autumn germinating species and this range of temperatures fits with autumn conditions. It is less likely that Matricaria will germinate in the summer months to become a summer weed.

Table 1. Effect of temperature (°C) on germination (%), for seed from four populations of Globe Chamomile.

	Temperature				
Population	5	15	25	35	45
Knungajin-Merredin Rd	0.0	0.0	36.0	23.3	0.0
Nangeenan Rd	0.0	0.0	12.7	18.7	0.0
Mukinbudin	0.0	0.0	24.7	20.7	0.0
Merredin	0.0	0.0	24.7	11.3	0.0
LSD (5%) Temperature 3.7, Population 3.3					

Light or dark conditions and scarification Seeds kept in darkness showed much lower germination than those seeds exposed to light (up to 3.3% compared to up to 49.3%; Table 2). Scarification did not increase the level of germination under the standard conditions (light). Use of cultivation at crop establishment/fallow maintenance is unlikely to stimulate additional germination. The action of tillage may bury Matricaria seed leading to increased longevity of the seed in the soil seed bank.

Table 2. Effect of light or dark conditions or scarification on germination (%) of seed from four populations of Globe Chamomile.

Population	Light	Dark	Scarification
Knungajin-Merredin Rd	49.3	3.3	51.3
Nangeenan Rd	41.3	0.7	40.0
Mukinbudin	37.3	0.0	28.7
Merredin	29.3	1.3	36.7
LSD (5%) Population 6.4, Treatment 6.4			

Depth of burial over time There was no difference in the behaviour of the three populations over burial depth and length of time the seed was buried. Depth of burial did have a real effect on the level of Globe Chamomile germination recorded at each of the three collection times (Figure 1).

A greater number of Globe Chamomile seeds persisted (remained viable) when buried at 2 cm and 10 cm than those on the soil surface. This was consistent for the first three collection times. This may indicate that there is some secondary dormancy being exhibited by these Globe Chamomile populations. However, following 24 months of burial, this changed, with more Globe Chamomile germinations recorded for the surface and 2 cm samples. There may be some breakdown in the dormancy of the Globe Chamomile seeds after an extended period, greater than 24 months depending on population.

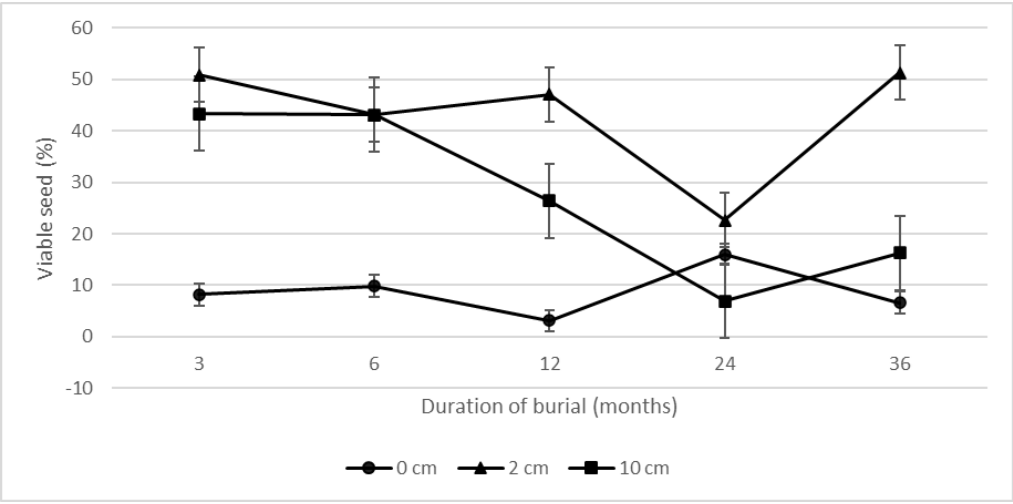
Data from work conducted in the late 1980s (Dodd and Lloyd 1988 and 1989) demonstrated that seeds can remain viable in the soil seed bank for at least five years, indicating that the seeds of this weed, although small, are capable of persisting for several years, if buried.

Initially there appeared to be a trend for a decline in the percentage of seeds that will germinate over time when the seeds were buried at 2 and 10 cm. However, testing of the final seed collection, following burial for 36 months, 50% of buried seed germinated from the samples buried at 2 cm. Low levels of seed were still viable following burial at 10 cm or storage on the soil surface after 36 months.

Having seed that retains viability for a number of years while buried, makes Matricaria a more serious weed issue in farming systems. Seed longevity will influence the time required to manage field

populations as recruitment from the soil seed bank will extend the time needed to reduce the population. There may also be implications for summer fallow management if cultivation is used and the use of soil inversion at crop establishment as these practices will bury seed to depths where it can remain viable.

Figure 1. Germination (%) of Globe Chamomile seed, averaged over three populations, seeds collected following burial at three depths for 3, 6, 12, 24 and 36 months (standard error bars shown).



ACKNOWLEDGMENTS

This research formed part of the Locally Important Weeds project, DAW00257, and was made possible by the significant contributions of growers through both trial cooperation and combined DPIRD and GRDC investment, the author would like to thank them for their continued support.

REFERENCES

Atlas of Living Australia (2021). INTERNET http://bie.ala.org.au/species, Accessed 15 November 2021.

Dodd, J. (1990). Pentzia (Oncosiphon) spp. In Western Australia: History, distribution and significance. Proceedings of the 9th Australian Weeds Conference, ed J.W. Heap p. 451. (Crop Science Society of South Australia, Adelaide).

Dodd, J. and Lloyd, S.G. (1988 and 1989). Department of Agriculture WA, Plant Industries Experimental Summaries.

Hedrick, P.W. and McDonald, C.J. (2020). Stinknet, a new invasive, non-native plant in the southwestern United States. *Desert Plants* **36**, 5-16.

Kolokoto, R. and Magee, A.R. (2018). Cape stinkweeds: Taxonomy of Oncosiphon (Anthemideae, Asteraceae). *South African Journal of Botany* **117**, 57-70.

Michael, P.J., Yeoh, P.B., Ota, N. and Scott, J.K. (2011). Climate change impacts on agricultural weeds in Western Australia. RIRDC publication No. 11/059. RIRDC Project No. AWRC 08-85.

Parsons, W.T. and Cuthbertson, E.G. (1992). Noxious weeds of Australia, Calomba Daisy pp. 296-298. Inkata Press.