BUOYANCY OF *FLORESTINA TRIPTERIS* SEED, AN INVASIVE EXOTIC WEED OF CENTRAL WESTERN QUEENSLAND

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ABSTRACT

Sticky florestina (*Florestina tripteris* DC.) (florestina) is an invasive weed present in central western Queensland. Recent higher rainfall years have aided the spread of florestina and there is potential for further increase in abundance and distribution. Florestina has several vectors for spread including vehicles, machinery, animals and waterways. Currently, the potential dispersal distance of florestina seed along waterways is unknown. This study investigated the duration of florestina seed buoyancy to determine potential dispersal distances in flowing water.

The buoyancy of florestina seeds was tested in a laboratory by placing lots of 50 seeds in 800 mL beakers containing 350 mL of water and subjecting them to various levels of agitation (no, low and high agitation). The length of time seeds remained buoyant was recorded. After an hour, 55.6% of seed remained floating in the no agitation treatment compared to 34% and 18% in the low and high agitation treatments respectively. After seven hours, 10% of seed remained floating in the no agitation, 11.6% in the low agitation and 5.6% in the high agitation. Greater than 94% of seed for all treatments had lost buoyancy within 24 hours of being placed in the water. The remaining seed stayed floating for various lengths of time with one seed still floating after eight days in the no agitation treatment. By having a greater understanding of how florestina spreads across the landscape, more effective management plans can be developed to improve land management outcomes.

Keywords: sticky florestina, hydrochory, water dispersal, distribution.

INTRODUCTION

Sticky florestina (*Florestina tripteris* DC.) (florestina) is an invasive weed originally from semi-arid North America that was reportedly introduced to central western Queensland in the 1960s as a contaminant in buffel grass seed (*Cenchrus ciliaris*). Local governments are reporting a significant increase in its distribution due to recent ideal growing seasons. Florestina has a short lifecycle and produces a large quantity of seed, with 10-25 seeds per flower head and multiple flower heads per plant (Soto-Trejo *et al.*, 2016). Recent soil samples undertaken in dense florestina infestations found that in the first 50 mm of the soil profile there was an average of 44,420 seeds/m^2 (Warren and Vogler, unpublished data). The seed is covered in short white hairs that when wet become sticky allowing them to easily attach to different transport mechanisms and spread. Disturbed sites are favoured by florestina such as roadsides, fence lines, stock routes and overgrazed paddocks (Rogers and Sparkes 2007).

The mechanisms for florestina seed spread have not been well studied. As an Asteraceae, one of the main dispersal mechanisms is the pappus which may be used for wind dispersal. In Mexico, *Florestina tripteris* is the most widespread species in the genus but has the smallest pappus consisting of 8 – 10 short scales, suggesting that the pappus is not involved in the long distance dispersal of florestina (Soto-Trejo et al, 2016 & 2017). Florestina is often found growing on the disturbed road edges of both gravel and sealed roads. Local observations in Queensland suggest vehicles, machinery and roadside slashers that move along these roads are a major mechanism of long distance dispersal of florestina seed. Since 2021, three new detections of florestina which support vehicular dispersal have been recorded along roadsides in New South Wales (Atlas of Living Australia, 2025). Other dispersal mechanisms of florestina include animals, humans and water.

Seed dispersal by water, hydrochory, can include both aquatic and terrestrial plants. In this study, an initial investigation of florestina seed buoyancy is conducted which will indicate its potential for dispersal by water.

MATERIALS AND METHODS

This study used a randomised complete block experimental design with three levels of water agitation (no, low and high agitation) and five replicates of each. Florestina seeds were collected in May 2022 near Ilfracombe in Queensland and the trial was conducted in September 2023 in lab conditions. Lots of 50 filled seeds (Figure 1) were placed in 800 mL tri pour beakers filled with 350 mL (6 cm deep) of tap water. Constant agitation was achieved by using two EverLast™ 247 Variable Speed/Angle Platform Rockers (model BR5000) (Figure 1). The rockers were both set at 49 reps per minute and had a tilt angle of 7.5° and 17.17° for low and high agitation treatments respectively to simulate two levels of water turbulence. The beakers for the no agitation treatments were placed on the lab bench to simulate still water. The study was conducted in two parts, due to available space on the rockers. Three replicates were started on the 14/09/23 and the remaining two replicates were started on the 20/09/23. Only individual seeds were tested in this trial and not whole flower heads due to individual seeds being released from the flowers heads when mature.

For all treatments, each seed lot was poured into the individual beakers and agitation time was started. The number of seeds that remained floating were counted every five minutes for the first hour, every hour for the next seven hours, at 24 hours and then daily until at least 90% of the seeds had sunk. Each beaker was stirred five times prior to every seed count to break surface tension. Seeds were considered floating when they were touching the water surface, all other seeds were considered sunk. Methods used were taken from (Boedeltje *et al.* 2003).

Data was analysed using Genstat (24th edition, VSN International Limited 2024) with treatment means and standard errors of the mean presented graphically.

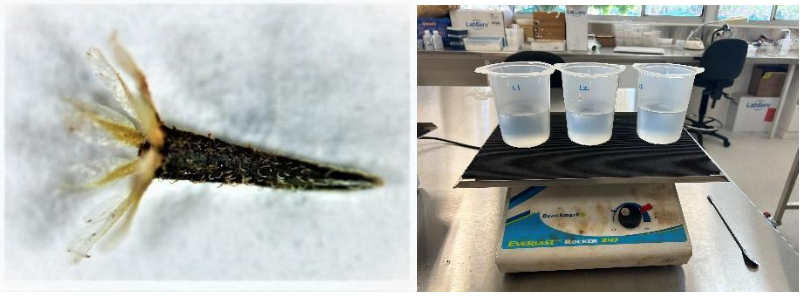

Figure 1. Individual florestina seed (left), EverLast™ Rocker with three beakers filled with 350 mL of water each containing 50 florestina seeds (right).

RESULTS

Buoyancy of florestina seed decreased over time with the high agitation treatment losing buoyancy faster than both the low and no agitation treatments. After an hour, an average of 55.6% of seed remained floating in the no agitation treatment compared to an average of 34% and 18% in the low and high agitation treatments respectively. After seven hours, an average of 10% of seed remained floating in the no agitation, 11.6% in the low agitation and 5.6% in the high agitation. For all treatments, on average 5.2% or less of florestina seeds remained floating after 24 hours (Figure 2). The remaining seeds stayed floating for various lengths of time with one seed still floating after eight days in the no agitation treatment.

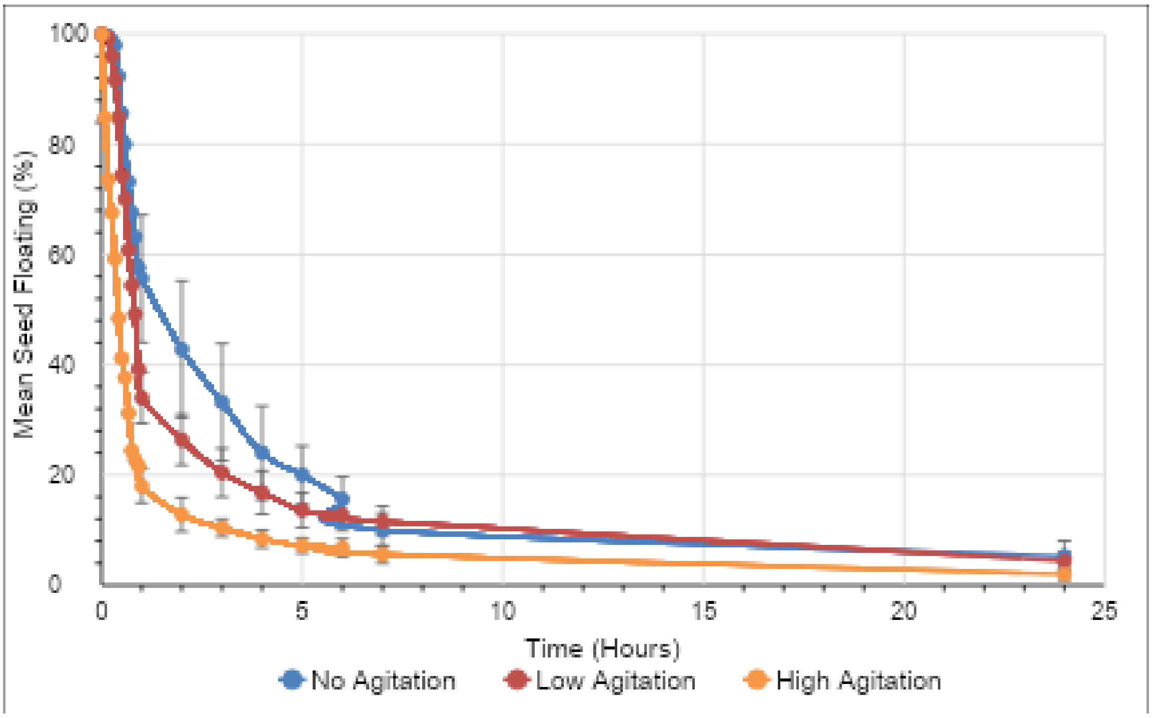

Figure 2. Buoyancy of florestina seeds in no, low and high agitation treatments over 24 hours. Error bars represent one standard error of the mean (P<0.05).

DISCUSSION

Florestina was found to have a short buoyancy period, where 90% of seeds in the high agitation treatment lost buoyancy within four hours. In comparison, prickly acacia (*Vachellia nilotica*) pods were found to remain floating for an average of five days with a maximum of 12 days in agitated water. Individual prickly acacia seeds were found to have no buoyancy (March *et al.* 2015). On the other end of the scale, pond apple (*Annona glabra*) seeds were found to remain floating for up to 12 months (Setter *et al.* 2008). A typical stranding pattern for species is when majority of seeds remain close to the parent plant and outlier individuals are dispersed longer distances (Nilsson *et al.* 2010). Mao *et al.* 2019, found that parthenium (*Parthenium hysterophorus*) seeds have a longer floatation time in river water compared to distilled water, due to more suspending particles which increases water density and therefore seed buoyancy. Florestina in this study was only tested in tap water, thus an increased buoyancy period may be seen within turbid river systems. Buoyancy provides an indication of potential dispersal distances by flowing water; it has been suggested that actual floating times may be in-between the still water and high agitation treatments (Vivian-Smith and Panetta 2005).

Buoyancy of seed is influenced by two factors. The first is due to buoyant force, where seeds are less dense than water and therefore have the ability to float (Carthey *et al*. 2016), e.g. pond apple seeds. The second factor influencing buoyancy is the surface tension of seeds. The pappus on florestina seeds increases the surface area to volume ratio acting like a ‘life jacket’ in the water. An additional treatment was conducted to demonstrate the impact of surface tension. Using the same method above, the no agitation treatment was repeated but no stirring occurred before each count. By having no agitation and not interrupting the surface tension, all 50 seeds remained floating for the length of the trial (nine days), providing an example of the role surface tension has on buoyancy.

Florestina in Queensland is predominately found in the Thomson - Barcoo - Cooper catchment which is the largest river basin in Queensland. One reference stated that the flood process at Cooper Creek was between 0.1 m/s and 0.3 m/s depending on the size of the flood (Australian Government, 2017). Therefore, florestina has the potential to travel 8.65 to 25.95 km in 24 hours before losing buoyancy, with potential for further travel from outlier seeds. During floods, waterways in western Queensland can significantly increase in size, potentially up to 40 km wide, thus expanding the potential area for florestina seed to be dispersed by water (Australian Government, 2018). Estimated dispersal distances may be useful for known riparian florestina infestations; however, origin of seeds may not be known for populations further afield which have been affected by floods and overland flows.

Seed distribution along waterways is not only dependent on seed buoyancy but a variety of other factors and therefore dispersal quantity and distances can vary substantially. Water course characteristics such as shape, size and flow can affect distribution (Nilsson *et al.* 2010). For example, small meandering rivers, have a greater opportunity to trap seeds and therefore have lower dispersal distances. Seeds can also be transported downstream on floating objects such as logs, algae and rafts of organic material (Nilsson *et al.* 2010). Seeds that have been submerged (no longer buoyant), still have the potential to travel downstream and germinate once returned to favourable conditions. This germination relies on the seed remaining viable following immersion in water for extended periods. A study on Siam weed seed (*Chromolaena odorata*) which is similar to florestina seed, found that immersion in fresh water for up 126 days did not reduce seed viability (Brooks *et al.* 2017). This suggests that the chance of establishment following immersion and movement downstream is likely dependent more on the seed reaching a suitable germination environment rather than whether the seed remains viable after immersion. Future studies are needed to investigate florestina seed viability following immersion in water.

CONCLUSION

Florestina seeds were found to have a short buoyancy period and therefore have the capacity to be dispersed by water with the potential to travel significant distances, particularly in flooding events. However, the quantity and distance of dispersal will be variable. This method of dispersal should be considered when developing management plans, such as surveying downstream from larger infestations and after flooding events.

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