

# THE EFFECT OF ORANGE OIL ON FREE-FLOATING AQUATIC WEEDS

## Literature Review

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# EFFECT OF ORANGE OIL ON FREE-FLOATING AQUATIC WEEDS

## OVERVIEW

- ✍ Current literature describing the effect of orange oil on three types of free-floating aquatic weeds (azolla, duckweed and salvinia) was explored.
- ✍ Orange oil is a natural, easy to apply, environmentally friendly weed control approach.
- ✍ Orange oil acts by breaking down the waxy coating on plant cell walls causing plants to lose water and die of dehydration.
- ✍ The use of orange oil is recommended in Australia by the New South Wales Department of Primary Industries and the Queensland Government for the control of free-floating aquatic weeds.
- ✍ Treatment with orange oil is most effective between spring and autumn on early and moderate weed infestations.

## INTRODUCTION

Free floating aquatic weeds are small aquatic plants that float on the water surface but are not rooted in the underwater soil. A weed is a plant growing where it is not desired. They cause damage to the environment and natural resources. The three most common types of free-floating aquatic weeds are Salvinia, Duckweed (Lemna species) and Azolla (Azolla species). Salvinia is declared a Weed of National Significance (WONS) due to its invasiveness and severe environmental, economic and social impacts [1]. Although Azolla and Duckweed are native to Australia, they are considered weeds when they spread rapidly on water bodies and limiting the light and oxygen available to other aquatic life.

## IMPACTS OF FREE- FLOATING AQUATIC WEEDS

Environmental	<ul style="list-style-type: none"><li>▪ Form thick mats that prevent light and oxygen from entering the water</li><li>▪ Creates unfavourable conditions for aquatic organism</li><li>▪ Death of submerged aquatic organisms reduces biodiversity</li></ul>
Economic	<ul style="list-style-type: none"><li>▪ Blocks irrigation channels (intakes, pipes &amp; pumps) increasing pumping time and cost</li><li>▪ Blocks commercial fishing nets resulting in reduced fish production</li><li>▪ Fences may collapse during flooding due to collection and build-up of weed</li></ul>
Social	<ul style="list-style-type: none"><li>▪ Thick mats for mistaken for firm ground endangering children and livestock</li><li>▪ Presents an ideal habitat for mosquito breeding</li><li>▪ Reduces the natural beauty of open water bodies</li><li>▪ Prevents recreational activities</li></ul>

## USE OF ORANGE OIL FOR THE MANAGEMENT OF FREE-FLOATING AQUATIC WEEDS IN AUSTRALIA

- ✍ Orange oil products are suitable for the control of salvinia, azolla and duckweed in New South Wales (NSW) and Queensland (QLD) [1].
- ✍ The NSW Department of Primary Industries (DPI) has listed orange oil as a method to control salvinia in their control manual [1].
- ✍ In Brisbane, orange oil has been used for the successful control of primary form salvinia [1]
- ✍ The table below summarises the effectiveness of various herbicides on the growth stages of free-floating aquatic weeds, as outlined by the NSW DPI [1].

Herbicide	Primary stage <sup>a</sup>	Secondary stage <sup>b</sup>	Tertiary stage <sup>c</sup>	Multilayered <sup>d</sup>
Orange oil	✓	✓	✗	✗
AQ200	✓	✓	✓	✓
Glyphosate	✓	✓	✓	✗
Immerse	✓	✓	✗	✗

<sup>a</sup> Primary: early stages of infestation, crowded plants, water surface visible

<sup>b</sup> Secondary: moderate infestation, water surface barely visible

<sup>c</sup> Tertiary: mature infestation, water surface is not visible

<sup>d</sup> Multilayered: display ridge-like thickening as layers build up

## ORANGE OIL

- ✎ Orange oil is an organic herbicide extracted from the peels of the orange fruit [2].
- ✎ The principal component of orange oil, d-limonene (>90%), is known for its herbicidal properties.
- ✎ Orange oil herbicides composed of 95-96% by weight of d-limonene and about 4-5% of other components is a highly effective knockdown (non-selective) herbicide [3].
- ✎ According to a US patent (No. 5,998.335) when orange oil herbicides were applied to vegetation, “most vegetation showed visible signs of stress (e.g., wilting or browning) within 2 to 24 hours of application of the herbicide” [3].
- ✎ The use of orange oil is an environmentally friendly weed control approach [4].

## BENEFITS OF USING ORANGE OIL

### ENVIRONMENT

- ✓ Natural product [3]
- ✓ More environmentally friendly than synthetic herbicides [3]
- ✓ Does not cause environmental pollution [3]
- ✓ Non-persistent which means it decomposes rapidly, preventing the accumulation of compounds in soil and its subsequent influence on non-target organisms [5]

### PERFORMANCE

- ✓ Orange oil is water-soluble which makes it easier to apply [5] [6]
- ✓ Orange oil binds to proteins at different sites than synthetic herbicides. This allows elimination of herbicide resistant weeds [6] [7]

### SOCIAL

- ✓ Pleasant citrus smell which allows use in any living environment [2]
- ✓ Non-toxic to humans and domestic animals [3]
- ✓ Pest and insect repellent [2]

## HOW IT WORKS

When the orange oil covers the surface of the leaves, it disrupts the cuticle, breaking down or dissolving the waxy coating on plant cell walls. It also contributes to the desiccation or burndown of young tissues [6]. This results in the plant losing its ability to retain water [3]. The damaged leaf cells leak water and the plants die of dehydration [8].

## MANAGEMENT CALENDAR

The following calendar outlines the management approach using herbicides for a typical year [10] [11].

		SPRING			SUMMER			AUTUMN			WINTER		
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Salvinia	Growth stage	Growth rate increases as temperature increases				Growth period			Winter dormancy				
Azolla													
Duckweed	Action	Best time for herbicidal control using Orange Oil or AQ200											

## HOW TO USE

Herbicide	Situation	Rate	How to use	Comments
Orange oil	Artificial water impoundments (golf course, dams, lakes, minor water impoundments, ornamental lakes) [9]	1L per 500m <sup>2</sup> of water surface area.	Mix 1-part product with up to 100 parts water and spray using a backpack sprayer directly onto the water's surface  For best results, avoid a single heavy application.  Apply several light applications over a 1 to 3 week period [1] [10] [9].  Refer product brochure for more details.	Not for use in [1] [10] [9]: <ul style="list-style-type: none"> <li>natural water bodies</li> <li>streams that reach natural water bodies</li> <li>dams holding water for human use</li> <li>water for potable consumption</li> <li>water bodies with an average depth of less than 1 m</li> </ul>

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