# Pilot

# Cabomba

# Re-Use

# Demonstration

# Project

A
Lake
Macdonald
Catchment
Care
Group
Initiative

A collaborative approach involving…

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Produced by

# Lake Macdonald Catchment Care Group

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# Pilot Cabomba Re-Use Demonstration Project

## Introduction:

*Cabomba caroliniana* is an introduced aquatic Weed of National Significance (WONS), originating from South America. Currently *C. caroliniana* infests Lake Macdonald in Cooroy, Noosa Shire. This totally submerged, attached aquatic plant forms dense monocultures in the lake, displaces native aquatic plants, reduces water quality and increases the costs of the maintenance of water supply equipment. The dense canopy of the plant inhibits wave action, reduces light penetration and chokes aquatic fauna breeding hollows. Leisure activities, boating, fishing, swimming, are all impeded by Cabomba, causing safety problems and making containment of the weed difficult. Cabomba has not been observed reproducing sexually in Australia though grows vigorously from fragments of the parent plant (WONS Cabomba Strategic Plan 2000). Anecdotal evidence suggests Cabomba fragments can re-hydrate and survive up to 48 hours without water (Phil Moran *pers com* 2003.) This is a cause for alarm as plant fragments can be inadvertently moved from one water body to another on leisure equipment.

Control of *Cabomba caroliniana* is limited to mechanical means in Lake Macdonald. Chemical control methods are not deployed as the lake supplies Noosa Shire's water. Draw down has been ruled out due to the scarcity of water supplies and the impact this method would have on the breeding sites of the endangered Mary River Cod (*Maccullochella peelii mariensis*). The Lake Macdonald Catchment Care Group has engaged CSIRO to undertake biological control investigations.

Mechanical control of Cabomba is achieved through the use of the Aquatic Weed Harvester (HV2600). This aquatic craft removes the canopy of Cabomba and the biomass is transported to a modified compacting truck. The Cabomba biomass is compacted in the truck and the liquid is separated from the vegetative mass. The liquid is transported to the Cooroy Water Treatment plant and solids of Cabomba are dumped at the Eumundi Road Refuse station.

The Lake Macdonald Pilot Reuse Demonstration Project investigated the potential to use worms to digest the Cabomba solids and turn the weed into a useable product.

Analyses of the nutrient and metal content of the treatments was conducted to investigate the suitability of Cabomba as a nutrient rich source for use in potting mixes, as a soil additive and/or a soil reviver product. Reuse of the harvested Cabomba could provide a useful and saleable product and also reduce the amount of Cabomba requiring disposal a refuse site.

## Methods:

Worms were employed to digest and convert *Cabomba caroliniana* into a product suitable for the nursery industry. Sixteen individual worm farms were set up in a shed at the Lake Macdonald Aquatic Nursery site.

A Worm Factory (8mx4m) was built to house the individual worm farms. The factory consisted of an open-sided roofed structure, built from reused timber and iron. The individual farms consisted of a used 15" 4*Wheel-Drive tyres, with drainage holes cut in the sidewall. The tyres were laid on the sidewall at slight angle, to favour the drainage hole. A layer of $10mm^2$ "snake and bird" wire was used to create the floor of the factory. A pervious layer of weed matting was firmly attached to the top of the wire floor to prevent any worms escaping through the base. A measured quantity of horse and cow manure, lucernes, and shredded newspaper were placed in the tyre and a light-proof carpet lid was secured to the top (Table 1). The worms were added to the individual worm farms 7 days later. Each Worm Farm Unit received weekly application of water (to point of run-off) and ½ cup of Turkey Starter Mash with 2 tablespoons of lime.

**Table 1: Worm Compost Mix recipe.**

| **Initial compost mix** |
|---|
| 1 x 10lt bucket Horse Manure |
| 2 x 10lt bucket Cow Manure |
| 1 x 10lt bucket tightly packed Lucerne |
| 1 Kg shredded old newspaper |
| Water to run-off weekly |
| ½ cup of Turkey Starter Mash weekly |
| 2 tablespoons of lime weekly |

Worm species

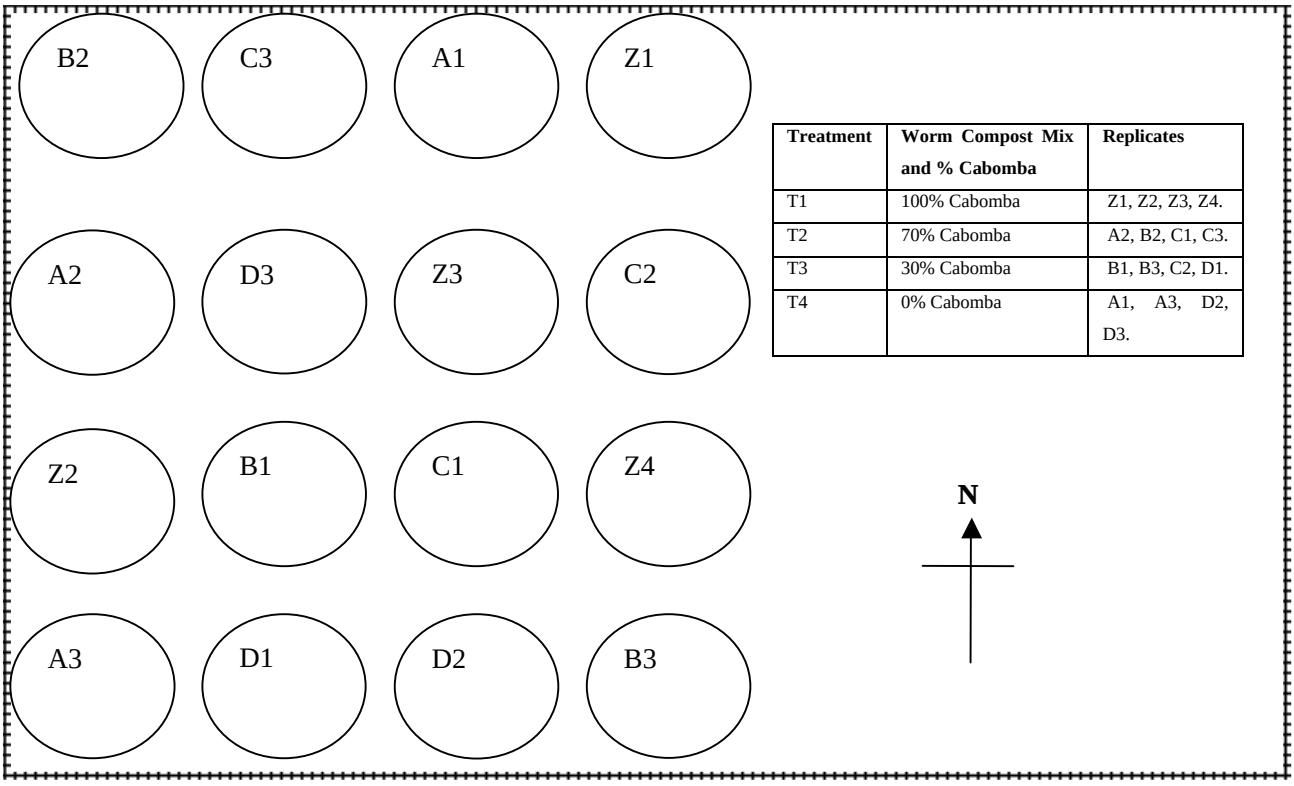
Worm types employed were “Red Worms”; “African Night Crawlers”; and “Tiger Worms” (Table 2). They were employed in equal ratios. These worm types are exotic and no native worms were sourced due to lack of adequate information and sources.

**Table 2: Worm species and common names**

| **Scientific Name** | **Common Name** |
|---|---|
| *Eudcillus eugeniae* | African Night Crawler |
| *Lumbrius rubellus* | Red Worm |
| *Eisenia foetida* | Tiger Worm |

Randomised Block Design

Sixteen individual worm farms were established in this experiment representing four treatments. There were four replicates within each treatment. Each replicate was randomly assigned to positions in the Worm Factory to minimise effects of location error.




| **Treatment** | **Worm Compost Mix and % Cabomba** | **Replicates** |
|---|---|---|
| T1 | 100% Cabomba | Z1, Z2, Z3, Z4. |
| T2 | 70% Cabomba | A2, B2, C1, C3. |
| T3 | 30% Cabomba | B1, B3, C2, D1. |
| T4 | 0% Cabomba | A1, A3, D2, D3. |

**Fig 1:** Worm farm layout showing aspect and random assignment of replicates.

Treatments

Four treatments were employed to test if Cabomba was digested by the worms (fig 1). Various levels of Cabomba input were used to determine at what ratio the Cabomba could be digested and turned into a useable product. The percentage volumes of wet Cabomba added to the overall Worm Compost Mix volume are described in Table 2.

**Table 3: Treatment assignment to Cabomba/Worm Compost Mix**

| Treatment | | |
|---|---|---|
| **T1** | No Cabomba | 100% Worm Compost Mix |
| **T2** | 30% Cabomba | 70% Worm Compost Mix |
| **T3** | 70% Cabomba | 30% Worm Compost Mix |
| **T4** | 100% Cabomba | No Worm Compost Mix |

Analyses

The Worm Compost Mix and worms were analysed for nutrient content at a NATA certified laboratory:- Natural Resources Science Laboratories, Department of Natural Resources, Mines and Energy, Brisbane.

The analyses of the nutrient and heavy metal content of the treatments were carried out in a sequential fashion.

Table 4 shows the analyses progression through the duration of the project.

**Table 4: History of Pilot Re-Use Project showing sampling sequences.**

| Stage | Date | Outcome |
|---|---|---|
| 1 | Jan 03 | 16 x established worm farms in Random Block Design |
| 2 | March 03 | Analyses of Worms and Worm Compost Mix (pre-Cabomba addition) |
| 3 | April 03 | Addition of Cabomba according to treatment type |
| 4 | July 03 | Analyses of Worm Compost Mix and Worms according to treatment type. |

# Results

Cabomba Analysis

Cabomba foliage analyses, under a Weeds of National Significance project 34505 & 34506, derived the values shown in Table 5.

**Table 5: Cabomba plant foliage composition (from Weeds of National Significance projects #34505 & 34506 pp13)**

| **Composition** | **Cabomba foliage values** |
|---|---|
| Boron mg/kg | 63.3 |
| Calcium % | 0.53 |
| Chloride % | 1.27 |
| Copper mg/kg | 12.0 |
| Iron mg/kg | 19000.0 |
| Magnesium % | 0.22 |
| Manganese mg/kg | 5400.0 |
| Nitrogen % | 2.13 |
| Phosphorous % | 0.17 |
| Potassium % | 1.77 |
| Protein % | 13.3 |
| Sodium % | 2.17 |
| Sulfur % | 0.41 |
| Zinc mg/kg | 73.0 |

Stage 2: Worm Compost Mix and Worms Analysis

Analyses of worms and Worm Compost Mix before the addition of Cabomba foliage produced the values shown in Table 6. The analyses were conducted two months after the ingredients were combined and housed in the worm farm. The worms were deemed to be breeding due to eggs present and observable increases in worm populations.

**Table 6: Stage 2 Worm Compost Mix and worm analyses results (before addition of Cabomba)**

| Composition | Worm Compost Mix values | Worm values |
|---|---|---|
| Aluminum mg/kg | 1100 | 320.0 |
| Boron mg/kg | 4.40 | 3.900 |
| Calcium % | 3.10 | 0.750 |
| Copper mg/kg | 15.30 | 21.50 |
| Iron mg/kg | 810.00 | 350.0 |
| Magnesium % | 0.160 | 0.170 |
| Manganese mg/kg | 99.00 | 97.00 |
| Nitrogen % | 1.970 | 11.09 |
| Phosphorous % | 0.190 | 0.790 |
| Potassium % | 0.170 | 0.900 |
| Sodium % | 0.031 | 0.469 |
| Sulfur % | 0.130 | 0.680 |
| Zinc mg/kg | 67.00 | 120.00 |

Stage 3: Addition of Cabomba according to treatment type

Freshly harvested *Cabomba caroliniana* was added to the Worm Compost Mix four months after the project's genesis. This was to ensure a homogeneous Worm Compost Mix, to "settle" the worms into their new environment and to ensure no mass worm migration.

Cabomba was added to the Worm Compost Mix (Table 1) in volumetric proportions according to the treatment type. After seven days all of the worms in the 100% Cabomba (Treatment 4) died, probably due to desiccation and loss of habitat. Over the course of a week the Cabomba gradually lost structure and collapsed to form a Cabomba ooze. The worms survived the first four days, but by day five only a few were alive. By day seven the complete population had perished. The Cabomba had dried up completely, with a significant loss of volume and worms were visibly desiccated.

Stage 4: Analyses of Worm Compost Mix and Worms according to treatment type.

The remaining (12) worm units were sampled. These samples were pooled into treatment types and the pooled samples were analysed. The results are presented in Table 7.

**Table 7: Analyses of worms and Worm Compost Mix after 3 months**

| **Composition** | **Worm Compost Mix** | | | **Worm values** | | |
|---|---|---|---|---|---|---|
| | Control **T1** | 30% Cabomba **T2** | 70% Cabomba **T3** | Control **T1** | 30% Cabomba **T2** | 70% Cabomba **T3** |
| **Aluminum mg/kg** | 5300.0 | 5200.0 | 5530.0 | 216.0 | 124.0 | 234.0 |
| **Boron mg/kg** | 18.10 | 21.00 | 19.60 | 5.120 | 7.040 | 6.385 |
| **Calcium %** | 4.080 | 3.470 | 2.530 | 0.451 | 0.386 | 0.494 |
| **Copper mg/kg** | 130.00 | 171.00 | 166.0 | 18.10 | 16.40 | 22.45 |
| **Iron mg/kg** | 3200.0 | 2760.0 | 3100.0 | 493.0 | 358.0 | 434.0 |
| **Magnesium %** | 0.456 | 0.449 | 0.481 | 0.124 | 0.120 | 0.132 |
| **Manganese mg/kg** | 1070.0 | 1050.0 | 1060.0 | 86.40 | 53.30 | 106.5 |
| **Nitrogen %** | 2.840 | 2.970 | 3.070 | 2.710 | 4.220 | 5.375 |
| **Phosphorous %** | 0.819 | 0.864 | 0.744 | 0.695 | 0.647 | 0.707 |
| **Potassium %** | 0.525 | 0.592 | 0.620 | 0.775 | 0.781 | 0.809 |
| **Sodium %** | 0.105 | 0.103 | 0.107 | 0.441 | 0.461 | 0.460 |
| **Sulfur %** | 0.466 | 0.504 | 0.503 | 0.653 | 0.636 | 0.650 |
| **Zinc mg/kg** | 244.0 | 251.0 | 251.0 | 106.0 | 103.0 | 113.5 |

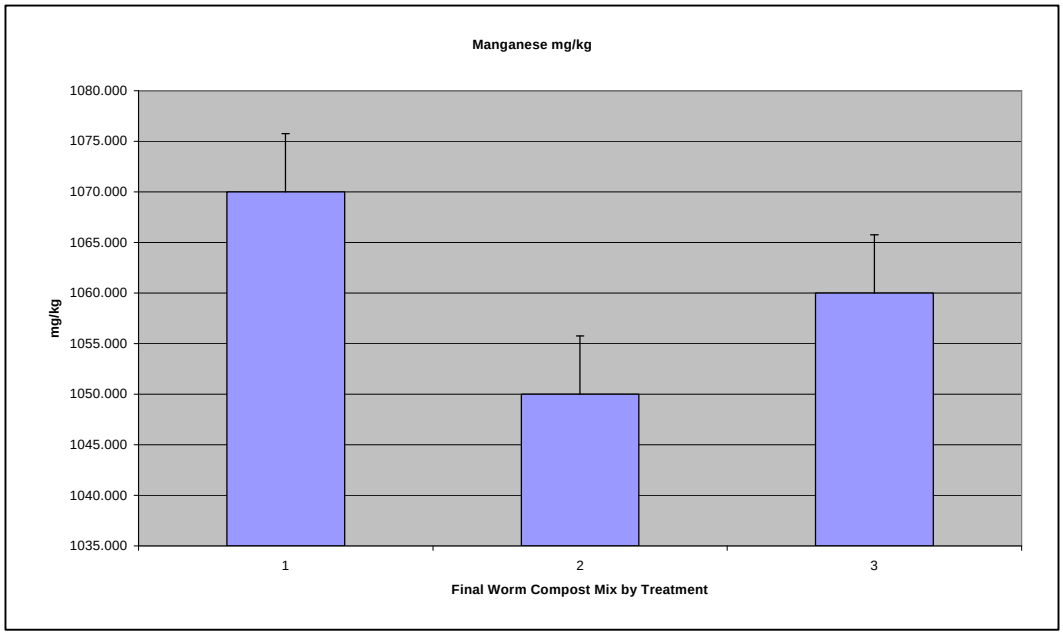



Figure 2: Final Worm Compost Mix by Treatment type for Manganese

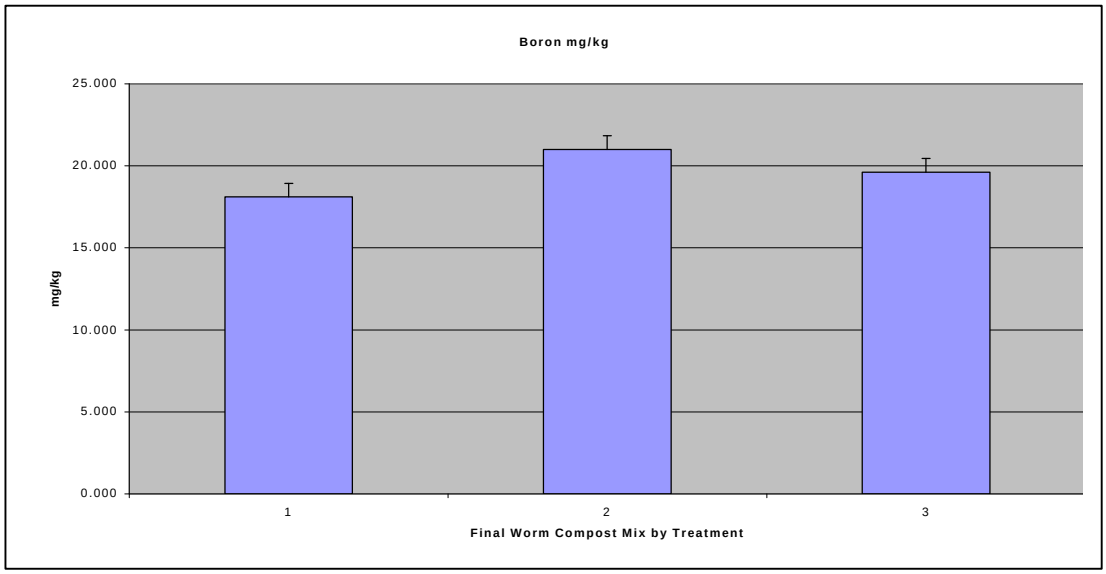



Figure 3: Final Worm Compost Mix by Treatment type for Boron

Recommendations

Re-use of Cabomba is possible through Vermiculture techniques, as shown by the Lake Macdonald Catchment Care Group project. Worms digest the Cabomba and thoroughly mix it through the Worm Compost Mix.

In line with Weeds of National Significance National Strategy

2.1.2: Change community attitudes and actions on Cabomba,

2.3.5: Change community attitudes and actions on control,

2.4.3: Maximise the availability and use of resources,

2.4.4: Provide cooperative management frameworks,

The Lake Macdonald Catchment Care Group recommends

1. The development of large-scale Vermiculture operations to consume Cabomba and other organic "waste" products within the region. These operations would require earthmoving machinery, a series of shallow trenches, liquid holding ponds, and artificial wetlands to remove nutrient pulses.

2. Continued analyses of
    - Worms
    - Worm Compost Mix
    - Worm liquid discharge

    to determine optimal levels of nutrients and other trace elements suitable for the nursery market.

3. Promotion of Cabomba Compost to retail and wholesale markets, along the lines of the successful "Charlie Carp" product.

4. Promotion of techniques developed through the Australian Government Envirofund "Cabomba Pilot Re-Use Project" to be applied region-wide for the re-use of aquatic weeds - a pest-to-profit approach.

## Appendix

## Photographic Records

Photograph 1: Project Officer preparing worm sample for analysis.

Photograph 2: Project Officer preparing worm and Worm Compost Mix sample for analysis.

Photograph 3: Addition of Cabomba to Worm Farm Unit.

Photograph 4: Terry Stokes, volunteer extraordinaire, preparing the worm farm units.

Photograph 5: Completed Worm Farm, showing 16 worm farm units, with holding days in right fore ground. Right foreground showing aquatic plant growing ponds.

Photograph 6: Mixing worms into fresh Worm Compost Mix.

Photograph 7: Local worm farmer, Mick Hughes, providing advise to Lake Macdonald Catchment Care Group volunteers - Ered Fox and Josh Birse

Photograph 8: Desiccated Cabomba (treatment 4) after 7 days.

Photograph 9: Local lad, Shane O'Connor, releasing worms to the worm farm unit.

Photograph 10: DNRM&E National Weedbuster Coordinator, Nicole Blackett, inspects Worm Farm with Phil Moran and Conor Neville.


Photograph 11: Cabomba Worm Farm unit at the Queensland Landcare Conference, Gympie.


Photograph 12: Queensland Landcare Conference delegates visiting the Lake Macdonald Catchment Care Group Aquatic nursery to view Worm Farm and native aquatic plant growing techniques.