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POND APPLE (*Annona glabra* L.) - INVESTIGATING NOVEL MECHANICAL CONTROL OPTIONS

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ABSTRACT

Pond apple usually occurs in swampy areas, but mechanical control may be a viable option in some locations during drier periods. Two machines, the Positrack™ and the Tracksaw™, have been trialled for initial kill rate, amount of follow-up control required, safety to field operators, cost-efficiency and selectivity (effect on native vegetation), compared to other control options. The Positrack™ is a tracked bobcat with a slasher-type attachment that cuts individual trees off near ground level and mulches them. It has no on-board herbicide application capability and requires an additional on-ground operator to apply herbicide by hand. The Tracksaw™ is a tracked mini-excavator with a chainsaw bar and spray applicator on the boom that cuts individual trees off near ground level and applies chemical immediately to the cut stump, requiring only a single operator. Initial trials were done in infestations of similar sizes and densities at the Daintree (Positrack™) and in Innisfail (Tracksaw™) in late 2009. Kill rates to date are 83% for Positrack™ mechanical, 95% for Positrack™ mechanical plus herbicide, and 78% for the Tracksaw™ combined treatment. If ongoing comparison proves either of these machines to be more cost effective, selective, and safer than traditional control methods, mechanical control methods may become more widely used.

Keywords: Pond apple, *Annona glabra*, mechanical, control

INTRODUCTION

Pond apple (*Annona glabra* L.) is a small semi-deciduous exotic tree from North, Central and South America. It has invaded freshwater swamplands, creek banks, seasonally flooded areas and the upper edges of mangrove swamps along the Queensland coastline (Swarbrick and Skarratt, 1994). Pond apple is considered to be a serious threat to Australia and is listed as a Weed of National Significance (Thorp and Lynch, 2000). It was also the highest ranked weed species in a Wet Tropics Bioregion weed risk assessment (Werren, 2003).

Since its introduction into Australia in 1886 (Sugars *et al.,* 2006), pond apple has invaded thousands of hectares of wetlands,

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riparian ecosystems and manmade landscape structures such as agricultural and domestic drainage systems. A number of control programs now exist throughout northern Queensland.

This study investigated two different machines - the Positrack™ and the Tracksaw™ - for their effectiveness as an initial control method, as well as the associated costs and follow up treatments required. Both machines are transportable, sole operator machines (however the Positrack™ requires additional operators if herbicide is to be applied), robust, and with the ability to maneuver amongst vegetation. They are, however, limited to operating under non-boggy conditions.

The trial sites were at the Daintree (16 °13.214 S, 145 °26.874 E) (Positrack™) and Innisfail (17°31'12" S, 146°0'39" E) (Tracksaw™) with pond apple infestations of similar size and density. This paper reports on the population structure of these two pond apple infestations in North Queensland, quantifies the effectiveness of two mechanical control methods, and discusses the broader management of pond apple infestations.

MATERIALS AND METHODS

Positrack™

The Positrack™ is a tracked bobcat with a slasher-type attachment that cuts individual trees off near ground level and mulches them. It has no on-board herbicide application facility, requiring herbicide to be applied to tree stumps by an on-ground operator. Therefore, effectiveness of both mechanical action only, and mechanical action plus herbicide application were tested.

The site in Daintree National Park consisted of pond apple interspersed with a mixture of native tree and shrub species. The original vegetation type is dominated by a melaleuca species over-story with an extensive pandanus under-story. Other significant native species present and threatened include gardenias, melastomes, palms and orchids. Pond apple trees were present in mid-story at a density of 6400/ha and seedlings were interspersed within site at a density of approximately 11000/ha. Trees on average were 5.7 m high with a diameter of 18.7 cm at the base and 6.6 cm at chest height (n = 850).

Within the site, 18 transects (20 m long x 3 m wide) were established, with all trees measured and pond apple seedlings counted. Six transects were assigned control, six Positrack™ treatment only, and six Positrack™ treatment plus herbicide application. The herbicide used was glyphosate ® (360 g L^{-1}) mixed with water 1:1 applied using a hand held pressure sprayer.

Tracksaw™

The Tracksaw™ is a tracked mini-excavator with a chainsaw bar and spray applicator on the boom that cuts individual trees off near ground level and applies herbicide immediately to the cut stump via a spray nozzle. It requires only a single operator. It was only tested using the combined mechanical action plus herbicide application, as it would be unlikely to be used without herbicide.

The Innisfail site consisted of pond apple interspersed with a mixture of native species. This area of degraded native vegetation consisted of a melaleuca, hibiscus and palm over-story with pandanus under-story. The pond apple trees were the mid-story at a density of 7500/ha with seedlings being 3300/ha. Average tree height was 6.9 m with a diameter of 20.3 cm at the base and 9.4 cm at chest height (n = 370).

Within the site, 12 transects (20 m long x 2 m wide) were established, with all trees measured and pond apple seedlings counted. Six transects were assigned as control and six as Tracksaw™ treatment (mechanical action and herbicide application together). The herbicide used was glyphosate ® (360 g L^{-1}) mixed with water 1:1.

Measurements

The efficacy of each treatment was measured at three monthly intervals (up to 12 months at the time of writing) as percentage of pond apple killed, amount of re-suckering, seedling recruitment and cost. Monitoring will continue until both sites are free of pond apple in order to allow for cost estimates to include follow-up control.

RESULTS

Positrack™

The Positrack™ was capable of moving freely around native trees to treat pond apple trees selectively. Each tree was reduced to fragments within 10 to 30 seconds, with only the shattered 15 cm high stump remaining. The largest tree killed was 60 cm in basal diameter and 8 m in height. The spinning cutter bars with associated push bar were capable of driving over and along fallen tree trunks, thus ensuring complete fragmentation. The result was a layer of mulched tree fragments with the over-story of natives remaining untouched. Under-story grasses and pandanus were effectively mowed.

As pieces of timber were being thrown from the machine it was safe to approach the cut stump only after the machine had moved on. As a consequence, there was a delay of approximately two minutes from when the stump was cut until herbicide application.

Tracksaw™

The Tracksaw™ also treated pond apple trees selectively while maneuvering around native trees, but its maneuverability was

inhibited somewhat by the articulated boom, its apparent greater mass and its low clearance compared to the Positrack™. The chainsaw bar on the end of the articulated boom reduced the machine's ability to move and it was required to work along the face of infestation.

The stems of the pond apple trees were cut flush to the ground with a typical chainsaw cut-stump appearance. The herbicide was applied within seconds of the stump being cut. As each tree was cut at the base, the tree was then swept to one side by the boom to facilitate forward movement. The largest tree killed had a 50 cm basal diameter and was 8 m in height.

Comparative Effectiveness

Table-1 shows the efficacy and costs of the two machines as used in this experiment. The initial cost includes machine operator, labour for herbicide application (Positrack™ only) and herbicide costs.

Table-1. Area treated, cost and efficacy of the Positrack™ and Tracksaw™ machines and pond apple regrowth 12 months after treatment application.

Treatments	Positrack™	Tracksaw™
Area treated in two days	1.5 ha	0.75 ha
% kill machine only	83	- NA
% kill machine and herbicide	95	90
% stumps resuckering (herb)	5	10
Initial no. seedlings/ha	11000	3300
No. seedlings emerging/ha	2600	18500
Initial cost to treat/ha	$2300	$2730

DISCUSSION

Machines

Both machines removed pond apple trees whilst minimally damaging native tree and shrub species. There are, however, notable differences in the landscape following treatment with the two machines. The Positrack™ creates mulch from destroyed plants, while Tracksaw™ leaves cut tree in place, making it difficult to move through treated areas. The increase in seedling density and suckering after Tracksaw™ treatment may be attributed to the type and level of disturbance and lack of mulching. The Tracksaw™ has the advantage of being able to extend the cutting bar several metres, for example to reach the other side of a small drain or creek, or even to treat right to a drain or creek edge, which the Positrack™ could not do.

The Tracksaw™ has herbicide application integrated into its control method and thus requires only a single operator, while the Positrack™ required herbicide application by hand. As the Positrack™ stump was fragmented, it allowed for a greater volume of herbicide to

be absorbed by remaining plant tissue. This may enhance herbicide uptake compared to traditional cut stump methods, which may compensate for greater time period between cut and herbicide application. The Positrack™ could potentially be easily modified to apply herbicide from one platform, thus eliminating extra labour costs and associated Workplace Health and Safety Issues.

Both machines require soil to be relatively dry to operate, which may limit the usefulness of this tool to certain times of year or situations. This does, however, correlate to traditional control methods which are usually carried out in drier months. The impact on natural environment where two machines were tried was minimal. The native over-story remained intact, although more so in Positrack™ site and under-story was quick to recover. The greatest off target damage occurred to saplings.

Follow-up treatment (i.e. monitoring and treatment of resuckering plants, missed plants and seedlings) would be considerably easier and thus less costly in infestations treated by Positrack™ due to mulching of fallen trees. Although pond apple wood is relatively soft (decomposing in a few years), the cut pond apple trunks remaining after Tracksaw™ treatment make access and follow-up treatment more difficult and time-consuming, and therefore more costly. Pond apple tree trunks also present a safety hazard to field operators applying follow up control treatments. Suckers up to 3.5 m in height were recorded after 12 months at both sites, with these potentially reproducing within the following year.

Cost

Traditional methods employed for large scale pond apple control have been labour-intensive and sometimes hazardous. The methods themselves are sound, cost-effective and appropriate to some situations and cannot be totally replaced, but mechanical control may provide an additional control option in some circumstances. The time, expense and hazards (e.g. crocodiles, snakes, personal injury) associated with manually treating large areas may be reduced by mechanical control techniques.

Holloway (2004) estimates average costs per hectare for cut stump and stem injection treatment of pond apple to be $2750 and $2660 respectively. This figure, although dated, is representative of the costs of manual herbicide treatment. Associated costs of safety issues, training, staff retention etc. are not quantified. The costs of pond apple control using Positrack™ and Tracksaw™ as described here are comparable, at $2300 and $2730 respectively, but may be associated with greatly reduced safety issues, training, and staff retention costs. The costs do not include those required for follow-up treatments, which will be necessary, and may be quite variable

between the two machines, as evident by the differing amounts of resuckering and seedling recruitment recorded at 12 months.

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