Drive-by shooting: Increasing weed treatment speeds using a skattergun

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Summary The Epple 'skattergun', a relatively new weed control device, is a compressed air driven applicator for soil applied herbicides. The device is mounted on a suitable vehicle and allows the operator to 'shoot' measured doses of tebuthiuron pellets up to 20 metres away from the distribution point. The device was developed to increase the herbicide application speed for control of prickly acacia (*Vachellia nilotica* ssp. *indica* L. Willd. ex Del. (Mimosoideae)) and other weeds.

A field trial to quantify the increased tebuthiuron pellet application speeds by tractor and buggy-mounted 'skatterguns' versus hand application of pellets from quad bikes was conducted in the Julia Creek area of north-west Queensland in 2016–2017. The trial involved the treatment of 60 × one hectare plots of varying densities of prickly acacia on Mitchell grasslands.

The trial found that hand application from quad bikes was comparable to slightly faster than the 'skattergun' at densities less than 20 plants per hectare. However, at higher densities, a 'scattergun' provided significantly faster application regardless of whether it was used from a tractor or buggy. At 50, 150 and 300 plants per hectare, a buggy-based 'skattergun' operator could treat 81%, 111% and 133% more plants per hour than a quad bike-based operator for the same densities, respectively.

The trial confirmed that the 'skattergun' is an efficient tebuthiuron application device that reduces labour whilst enabling significantly more prickly acacia and other weeds to be treated within rangeland and savanna environments.

Keywords Prickly acacia, *Vachellia nilotica*, 'scattergun', tebuthiuron, Mitchell grasslands.

INTRODUCTION

Prickly acacia (*Vachellia nilotica* ssp. *indica* L. Willd. ex Del. (Mimosoideae)) is an exotic thorny tree that grows 4–5 m high and occasionally to 10 m. Native to the Indian subcontinent, it was introduced into Australia for shade and fodder provision, but is now a landscape level weed problem affecting large expanses of western Queensland and other areas of Northern Australia (Spies and March 2004). It is recognised as a Weed of National Significance in Australia.

To improve prickly acacia management, the Queensland Department of Agriculture and Fisheries has led various initiatives (March *et al*. 2017) during 2013–2018. A priority activity of these initiatives has been the field testing and refinement of new control tools, including those which increase the efficiency of current treatment methods.

While the authors have observed a significant increase in tebuthiuron (e.g. Graslan herbicide™) pellet application for prickly acacia control since the 1990s, this has primarily been through hand application for low and medium densities. The 'skattergun', developed in 2013–2014, became a focus of control tool refinement as it potentially enabled improvements in treatment speeds for prickly acacia infestations of different densities. The device is a compressed air driven applicator for soil applied residual herbicides. When mounted on a suitable vehicle, it allows the operator to 'shoot' measured doses of tebuthiuron pellets up to 20 metres away from the distribution point.

A trial was conducted aimed at assessing the efficiency of the 'skattergun' compared with current hand application methods and identify optimal situations for use.

MATERIALS AND METHODS

Site details The trial was undertaken at 'Wyaldra Station' (20°21′S, 141°51′E), a cattle property located approximately 60 km north of Julia Creek in north west Queensland. The trial site consisted of flat Mitchell grasslands dominated by *Astrebla* spp. with deep shrink swell grey clay soils.

Experimental design The trial was set up during September 2016 with additional plots for buggy-based 'skattergun' application set up in April 2017. Forty-eight randomised 250 × 40 m (1 ha) plots were established across a 6.6 km range of grassland to incorporate 4 treatments and 12 replicates of varying plant density. The plot width was restricted to enhance visibility of plants to be treated and reduce search effort as a factor of subsequent treatment times. All plots were marked with star pickets on each corner and midway along the two longer sides of the plot.

All plants in each plot were counted and recorded according to height categories of <0.5, 0.5–1, 1–2, 2–4 and >4 m. There were 4 replicates of 3 densities categories for each treatment. The density categories were low (<50 plants ha^{-1}), medium (50–150 plants ha^{-1}) and high density (>150 plants ha^{-1}). Densities of individual plots varied from 10 to 336 plants ha^{-1}.

The treatment chemical was tebuthiuron, with the Graslan™ herbicide pellets used for both 'scattergun' and hand application. Tebuthiuron at 200 g kg^{-1} of product is registered for prickly acacia at a treatment rate of 1.5 g m^{-2} calculated on the basis of the area of the canopy extending to 30 cm beyond the drip line. This means that more herbicide needed to be applied for larger trees.

The treatment types included a buggy-mounted 'skattergun', tractor-mounted 'skattergun', hand application from a single quad bike, hand application from two quad bikes working together and a control. Brett Epple, the developer of the 'skattergun' applied 'skattergun' treatments while an experienced weed control contractor was used for plots treated by hand application.

The time and amount of herbicide to treat each plot was recorded. The average amount of herbicide used per plant was calculated. Regression analysis was used to determine differences in treatment application speeds expressed as plants per hour and hectares per hour. Genstat 16th Edition (2013) was used for regression analysis.

Due to insufficient rainfall following treatment, further monitoring is required to assess mortality rates. This has not hindered the trial in achieving its principal aim of determining treatment efficiency differences and potential advantages or otherwise of the 'skattergun'.

RESULTS

Herbicide usage Average herbicide use $plant^{-1}$ was generally lower for 'skattergun-based' application with the greatest difference of 5.1 g $plant^{-1}$ observed between the tractor-based 'skattergun' and hand application from two quad bikes (Table 1).

A buggy-based 'skattergun' and hand application from a single quad bike are the best relative measures for comparison of treatments. Both use a single operator and the 'skattergun' is more likely to be used from a buggy than a tractor. The difference in herbicide usage between these two application methods was 0.8 g $plant^{-1}$ or 5.1%.

Treatment speed – plants per hour Regression analysis accounted for 87.4% of variance and determined that the treatment speeds between treatment methods were significantly different ($F<0.001$, $P<0.05$) (Figure 1). Treatment speeds expressed in terms of plants $hour^{-1}$ were similar for densities up to about 20 plants ha^{-1} (Figure 1). Hand application provided some efficiency advantages below this density although this only occurred for two plots (one with hand application from a single quad bike and one from two quad bikes).

By ~30 plants ha^{-1}, treatment speeds were consistently faster for both types of 'skattergun' treatment compared to hand application from quad bikes – even the two quad bike treatment (Figure 1). The 'skattergun' demonstrated significantly higher treatment speeds (plants treated $hour^{-1}$) above densities of ~30 plants ha^{-1}. At 50, 150 and 300 plants ha^{-1}, a buggy-based 'skattergun' operator could treat 81%, 111% and 133% more plants per hour than a quad bike-based operator for the same densities, respectively (Figure 1).

Treatment speed – area per hour Regression analysis accounted for 94.6% of variance and determined that the treatment speeds between a single quad bike and a buggy with a 'skattergun' were significantly different ($F<0.001$, $P<0.05$) (Figure 2). In particular, there was a significant treatment speed advantage for the buggy-mounted 'skattergun' relative to hand ap-

Table 1. Average herbicide usage per plant for trial treatments.

Treatment	Average herbicide usage (g $plant^{-1}$)	Percentage difference between 'Skattergun' – buggy and other treatments
'Skattergun' – tractor	14.8	− 6.3%
'Skattergun' – buggy	15.8	–
Hand application – 1 × quad bike	16.6	+ 5.1%
Hand application – 2 × quad bikes	19.9	+ 25.9%

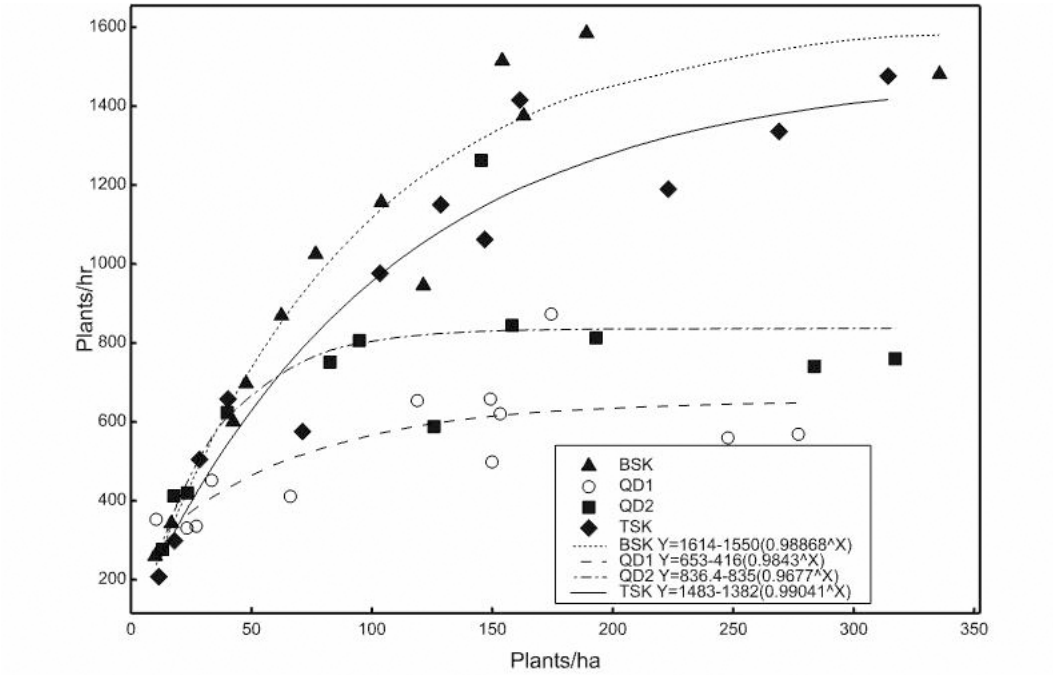

Figure 1. Comparative treatment speeds (plants per hour) of 'skattergun' versus hand applied treatments. (BSK – Buggy 'skattergun'; QD1 – One quad bike; QD2 – Two quad bikes; TSK – Tractor 'skattergun').

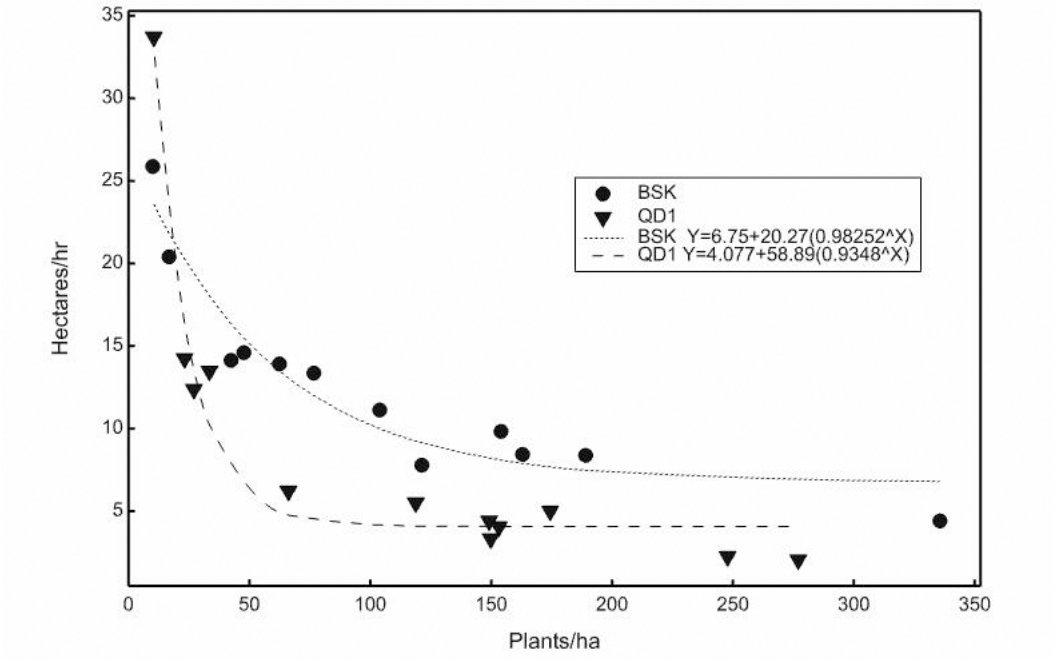

Figure 2. Comparative treatment speeds (hectare per hour) of the buggy-mounted 'skattergun' versus hand application from a single quad bike. (BSK – Buggy 'skattergun'; QD1 – One quad bike).

plication from a single quad bike with approximately twice the treatment rate observed for all plant densities above about 50 plants ha^{-1} (Figure 2).

DISCUSSION

Herbicide usage Herbicide usage for both 'skattergun' treatments was lower than hand applied treatments, though only markedly for hand application when using two quad bikes. Plant heights were relatively consistent for all treatments except those treated using two quad bikes. The plots for this treatment had a higher proportion of >4 m trees (4–6% higher) relative to other treatment plots requiring a higher rate of herbicide application per tree in accordance with the herbicide label. This, coupled with individual operator variance likely explains the higher usage of herbicide for the hand applied treatment using two quad bikes.

Treatment speed Based on observations during the trials, the 'skattergun' was able to achieve significant treatment speed advantages as the operator could dispense herbicide up to 20 m from the target plant. Hand application from quad bikes required operators to be closer to target plants (generally 0.5–3 m), necessitating greater distances to be travelled and thus requiring more time.

The treatment speed advantage of the 'skattergun' becomes pronounced when expressing the data as area treated time per unit. For example, at a density of 100 plants per hectare, a buggy-mounted 'skattergun' can treat ~40 ha more in an 8 hour day than a single quad bike which is about double the area that could be treated by the single quad bike.

Field observations have indicated the operational costs of using a buggy versus a quad bike are similar. The potential speed advantage of a quad bike, when traversing Mitchell grasslands, was only evident in the result for the 10 plants ha^{-1} plot.

It is interesting to note that the use of two quad bikes for hand application treatment did not double the treatment speed relative to using one quad bike. This result may be due to operators overlapping their search area either from over-checking their arbitrary common search boundary or the 40 m plot width was too narrow to allow the two quad bikes to operate efficiently.

Optimal situations for use Based on the outcomes of this and previous trials and case studies undertaken by Queensland Department of Agriculture and Fisheries (QDAF) through the War on Western Weeds initiative, optimal situations for use of the 'skattergun' have been identified.

The 'skattergun' is best used for prickly acacia control on flat to undulating plains at low to medium densities, from upwards of 20 plants ha^{-1}. Densities of 10–20 plants ha^{-1} could be treated by either 'skattergun' or hand application while sparse infestations under 10 plants ha^{-1} may be more efficiently treated by hand application from a quad bike.

Further analysis is required, but it is expected that treatment of high density infestations will be more efficient using broad-scale aerial application of tebuthiuron or perhaps double chain pulling with bulldozers. In either case, at high to very high densities, 'skattergun' use may be limited when air pressure cannot be maintained for effective pellet dispersal.

It is also noted the 'skattergun' treatment using tebuthiuron cannot be used in close proximity to native trees or watercourses due to herbicide registration restrictions associated with tebuthiuron based chemical products.

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