Use of the heavy duty blade plough for control of woody regrowth in Central Queensland

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Summary

Trial plots were set up at four sites in Central Queensland to examine the influence of ploughing depths of 7 to 30 cm on the control of regrowth of brigalow (*Acacia harpophylla*) and associated woody species. The percentage control of brigalow increased with increasing depth of ploughing from 42% at 8 cm to 84% at 20 cm, and of individual woody species other than brigalow from 0 to 100% at 8 cm to 77 to 100% at 17 to 30 cm. The heavy duty blade plough gave acceptable control of all woody regrowth with a single ploughing at 20 cm depth in late summer. It did not invert the soil and dislodged small stumps.

Introduction

A sound cropping programme in the brigalow region of Central Queensland enables the cost of development to be recouped and ensures that most woody regrowth is controlled (Johnson, 1964). Until recently, one way disc ploughs or offset discs have been the most common primary tillage implements. The influence of depth of ploughing on brigalow regrowth control has been studied by Coaldrake (1967), while Johnson and Back (1973, 1974) have examined the effectiveness of single and double disc ploughings throughout the year.

The heavy duty blade plough was introduced to Central Queensland in early 1979 and rapidly achieved acceptance by property owners as a means of controlling woody regrowth. No information on its efficacy was available, although it appeared that some differences could be expected because of the different cutting action.

Four trials were set up on three properties in Central Queensland to examine the effect of ploughing depth on the kill of woody regrowth achieved by a single ploughing at the end of summer.

Materials and methods

The number and species of regrowth in each plot were recorded in permanently located belt transects 2 m wide before ploughing in early April 1979 and 64 weeks after ploughing in July 1980.

The main regrowth species encountered were brigalow, yellow wood (*Terminalia oblongata*), scrub holly (*Heterodendrum diversifolium*), false sandalwood (*Eremophila mitchellii*) and currant bush (*Carissa ovata*). Also present but less common were velvet tree pear (*Opuntia tomentosa*), nipan (*Capparis lasiantha*), turkey bush (*Erythroxylum australe*), limebush (*Eremocitrus glauca*), broombush (*Apophyllum anomalum*), whitewood (*Atalaya hemiglauca*) and *Diospyros ferrea* var. *humilis*. Details of the species composition, density, the height of regrowth and the soil type at each site are given in Table 1.

The treatments applied at each site are shown in Table 2. The heavy duty blade ploughs used were manufactured by Symonds Products and were of the trailing type with three cutting feet. The feet were up to 2 m wide and set so that they cut through the soil on a horizontal plane, causing minimal soil inversion. The depth of ploughing was an average depth, with local variation of ± 3 cm. All sites chosen were on areas without gilgais or other features that would have made ploughing at a constant depth difficult.

Soil moisture at the time of ploughing was low at all sites except Site 1 where grass growth was evident. Rainfall between ploughing and final observations was well below average, with less than 50 mm during the first 6 months after ploughing and a total of 400 to 475 mm during the 64 weeks before assessment of the results.

Regression analysis between percent kill and depth of ploughing was carried out for brigalow and total woody species using an arc sine transformation of percent kill. The effect of shallow (7 to 9 cm) and deep (17 to 30 cm) ploughing on the control of associated species was determined by combining data for each species across sites.

Results

The percent kill of brigalow and total woody species increased as ploughing depth increased (Figures 1a and 1b respectively). The depth required to achieve an 80% kill of brigalow was 18.6 cm (95% confidence interval of the population 16.4 to 21.0 cm) and of total woody species was 19.2 cm (95% confidence interval of the population 17.7 to 20.8 cm). At a ploughing depth of 20 cm,

Table 1 The initial composition and density (number ha^{-1}) of woody regrowth species and the soil type at the four sites

	Site 1	Site 2	Site 3	Site 4
total regrowth	14 650	9100	5000	4600
brigalow	14 650	6300	3900	3000
yellow wood	n.p.[1]	700	150	1000
currant bush	n.p.	1000	100	n.p.
scrub holly	n.p.	350	400	200
false sandalwood	n.p.	300	200	n.p.
others	n.p.	400	200	500
height of regrowth (m)	1.5–4.0	0.8–1.8	1.0–3.5	0.6–2.2
soil type (Northcote, 1974)	Ug5.24	Db1.12	Ug5.32	Ug5.34

[1] n.p. — not present at this site

Table 2 The depth of ploughing, replicates, plot and sampling areas for the four sites

	Site 1	Site 2	Site 3	Site 4
depth of ploughing (cm)	8, 17, 27	9, 23	7, 20, 30	21
replicates	3	3	1	1
plot dimensions (m)	60 × 5	60 × 9	42 × 18	80 × 50
belt transect size (m)	30 × 2	60 × 2	30 × 2	30 × 2

Figure 1 The relationship between depth of ploughing and percent kill of (a) brigalow and (b) total woody species, using data from all sites. (An arc sine transformation was used to linearise the Y-scale.)

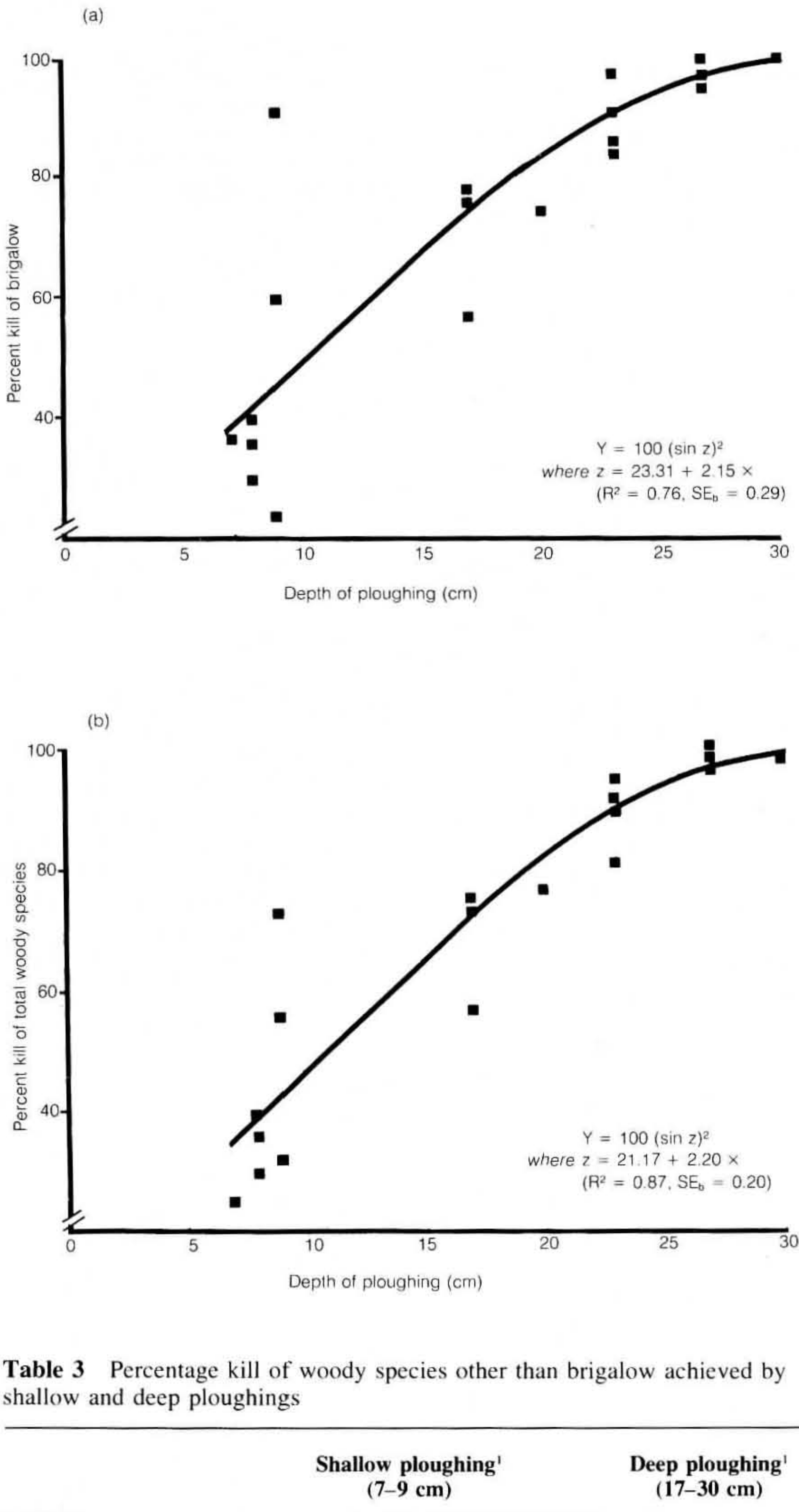

Table 3 Percentage kill of woody species other than brigalow achieved by shallow and deep ploughings

	Shallow ploughing[1] (7–9 cm)	Deep ploughing[1] (17–30 cm)
yellow wood	44 (41)[2]	86 (88)
currant bush	85 (80)	99 (72)
scrub holly	0 (42)	90 (29)
false sandalwood	100 (30)	100 (22)
broombush	20 (5)	77 (13)
limebush	11 (18)	92 (12)
Diospyros ferrea	0 (9)	100 (5)

[1] Data were combined across sites and depths for three shallow and six deep ploughing treatments.
[2] Values in brackets are total plant numbers on which the percentages have been calculated.

kills of 84% and 82% can be expected for brigalow and total woody species respectively. For a particular ploughing at 20 cm, the 95% confidence interval for percent kill was 51 to 100% for brigalow and 59 to 97% for total woody species. Insufficient data were available on species other than brigalow to determine a separate regression for each woody species.

The kills of associated species from shallow and deep ploughing are presented in Table 3. At the shallow depth, kills ranged from zero to complete while for deep ploughing the range was 77 to 100%. For most species, the deeper ploughing resulted in higher kills. False sandalwood and currant bush were well controlled by the shallow ploughings.

The heavy duty blade plough operated easily in regrowth up to 3 m high, although in dense stands above this height some blockage problems did occur. There were no problems maintaining ploughing depth at greater than 10 cm. Small stumps were readily removed from the soil.

Discussion

A single blade ploughing in late summer at a depth of 20 cm would give an 84% kill of brigalow (estimated from the regression equation). This contrasts markedly with the results of Coaldrake (1967), who reported only a 52% kill after two disc ploughings at 20 cm and found that it required four disc ploughings over a period of two years to give the 80% kill which was achieved by a single blade ploughing in April. However, direct comparisons are inappropriate as the site studied by Coaldrake (1967) was gilgaied (vertical interval up to 1 metre) and many suckers were missed by the plough.

A more useful comparison is with Johnson and Back (1974). The best kill of brigalow suckers obtained by ploughing with a heavy duty one-way disc plough was 48% with a March ploughing at 10 cm. Using the regression calculated for the blade plough, ploughing at 10 cm should give a 50% kill. These results are similar, although care must be taken when predicting kills from the regression line at the lower end of the range where there is high variability in the data. Coaldrake (1967) reports that offset discs ploughing at 10 cm gave a 52% reduction in suckers on strongly gilgaied land.

Thus it appears that offset discs, one-way disc ploughs and blade ploughs can be expected to give approximately 50% kill from a single ploughing in late summer if set at 10 cm. Because of the similarity at 10 cm it is reasonable to suggest that the three types of ploughs would give similar kills at all depths. However, an important consideration is the ability of the various machines to plough at depth. Johnson (1964) reported that the effectiveness of ploughing with one-way discs decreased as the height of suckers increased, largely due to inadequate penetration of the plough. This problem does not occur with the blade plough. Over 90% of brigalow suckers arise within 10 cm of the soil surface (Coaldrake, 1967) and therefore when the blade plough is set at 15 cm, the cutting surface cuts through very few lateral roots and no stems. Penetration of dry soil is also much less difficult than with discs. With a high density of suckers over 3 metres tall the blade plough can become blocked, and this reduces the speed of operation.

Although Johnson (1964) reported that ploughing at 20 to 25 cm gave quicker sucker control, he also indicated that at this depth soil inversion may cause poor crop growth on some soil types. There is no soil inversion with the blade plough and this enables shallow-surfaced duplex soils to be ploughed for regrowth control.

Although the effect of ploughing on associated species has received little attention, the results from this experiment are in general agreement with those of Johnson (1964) and Beeston and Webb (1977). False sandalwood is a strongly tap-rooted species and was readily controlled by shallow ploughing, whilst limebush and yellow wood required a deep ploughing to give reasonable control. Scrub holly and broombush were the most difficult species to control, and although both species occur as small trees in virgin brigalow scrubs they do not constitute a serious regrowth problem in Central Queensland.

The cost of ploughing with the heavy duty blade plough varies from $55 to $62 per hectare on level areas and rises to $75 per hectare on gilgaied country. These costs are higher than for heavy duty offset discs, which range from $40 to $45. The higher cost of initial ploughing with the blade plough is justifiable as it reduces the amount of damage to tillage implements caused by stumps.

The heavy duty blade plough appears to give a similar level of regrowth control to other heavy duty ploughs used in the brigalow community. The advantages of the blade plough include easier ploughing at depth, lack of soil inversion and the removal of small stumps from cultivation. The major limitation is that it is difficult to operate in gilgaied or other uneven-surfaced situations. With the great potential for grain growing in the northern brigalow areas (Nix, 1980), it is probable that the heavy duty blade plough will have an important role to play in reducing the time required to free cultivation from regrowth and small stumps and will be widely used for regrowth control and primary tillage.

References

Beeston, G. R. and Webb, A. A. (1977). *The Ecology and Control of* Eremophila mitchellii. Botany Branch Technical Bulletin No. 2, Queensland Department of Primary Industries, Brisbane.

Coaldrake, J. E. (1967). Depth of ploughing in relation to depth of suckering and soil type in the control of root suckers of brigalow (*Acacia harpophylla*). *Australian Journal of Experimental Agriculture and Animal Husbandry* **7**:523–7.

Johnson, R. W. (1964). *Ecology and Control of Brigalow in Queensland*. Queensland Department of Primary Industries, Brisbane.

Johnson, R. W. and Back, P. V. (1973). Influence of environment on methods used to control brigalow (*Acacia harpophylla*). *Queensland Journal of Agricultural and Animal Sciences* **30**:199–211.

Johnson, R. W. and Back, P. V. (1974). Control of brigalow (*Acacia harpophylla*) regrowth by single and double ploughings. *Queensland Journal of Agricultural and Animal Sciences* **31**:351–61.

Nix, H. A. (1980). Resources of the Capricornia Region. *In Proceedings of the First Annual Symposium of the Central Queensland Sub-Branch, Australian Institute to Agricultural Science. May 1980*. pp. 1.1–1.14.

Northcote, K. H. (1974). *A Factual Key for the Recognition of Australian Soils*. Fourth Edition. Rellim Technical Publications, Adelaide.

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