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# COMBINATION OF CROPPING AND SPRAYING TO CONTROL BRIGALOW (ACACIA HARPOPHYLLA) SUCKERS

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SUMMARY

**A stand of four-year-old brigalow suckers was converted to highly productive sown pastures after the growing of either a winter or summer crop and post-harvest spraying of brigalow regrowth. Winter cropping without follow-up spraying reduced sucker densities by 89% compared with 56% reduction following summer cropping. However, the combination of either summer or winter cropping and post-harvest spraying of brigalow regrowth 5 to 10 months after planting reduced sucker densities by 95-99%. Misting with 0·56 kg ha$^{-1}$ acid equivalent 2,4,5-T in diesel distillate or boom spraying with 1·12 kg ha$^{-1}$ a.e. 2,4,5-T in water killed 76-97% of the brigalow regrowth which remained after crop preparation.**

**Buffel grass (*Cenchrus ciliaris*)—green panic (*Panicum maximum* var. *trichoglume*) pastures were established during the cropping phase.**

## I. INTRODUCTION

As a consequence of the rapid large scale clearing of brigalow forests in Queensland, large areas of brigalow regrowth, often in excess of 1 000 ha, occur on many properties. Spraying with 2,4,5-T and ploughing are both used to bring this regrowth under control.

Where brigalow regrowth is dense and is not controlled for a number of years, the introduced grasses sown after pulling and burning die out. Spraying, if delayed until this stage, can convert these brigalow dominant areas into native grass pastures. This is a low cost-low return approach.

Annual cropping has been shown to be a very effective method of controlling brigalow regrowth (Johnson 1964). Coaldrake (1967) demonstrated that ploughing need be no deeper than 10 cm. After 3 years of annual cropping the suckers are effectively controlled and introduced pasture species such as green panic (*Panicum maximum* var. *trichoglume*) and buffel grass (*Cenchrus ciliaris*) can be sown in a well prepared seedbed and the area returned to highly productive pastures. This is a high cost-high return approach.

On properties used primarily for beef production the area of cultivation which can be economically and physically maintained for cash and forage crops is limited. Where regrowth covers extensive areas its replacement by improved pastures using a 3-year annual cropping programme is often too slow and an equally effective method of control to allow more rapid replacement would be advantageous. Another consideration is that many properties, particularly in the western and northern part of the brigalow belt, are marginal for economic cropping. In these circumstances there would be real merit in reducing the length of the cropping period.

The aim of this experiment was to evaluate the use of a combination of cultivation and spraying to convert an area of dense brigalow regrowth to improved pastures relatively free of suckers.

## II. MATERIALS AND METHODS

### Area

The experiment was carried out on the Brigalow Research Station situated about 32 km north-west of Theodore. Average annual rainfall is approximately 700 mm, two-thirds of which falls during the period November to March.

The experimental area had been pulled and burnt in 1963. It was originally covered by a brigalow-wilga (*Geijera parviflora*) forest with Ellangowan poison bush (*Myoporum deserti*) prominent in the understorey. The soil is a dark cracking clay—Northcote Ug 5.24, Ug 5.25 (Webb 1970).

After the initial burn, the area was sown to introduced pasture species, Rhodes grass (*Chloris gayana*), buffel grass and green panic. Prolific brigalow regrowth followed the initial burn and at the commencement of the trial in 1968 the suckers were about 1 m tall.

### Design

A split-plot design was used with the season of cropping (winter and summer) being the whole plot treatments. Seven sub-plot treatments involved the use of 2,4,5-T at various times after the sowing of the crops. Four replicates were treated.

Whole plots were 140 m x 24 m and sub-plots 24 m x 15 m. Permanent quadrats 20 m x 1·5 m were established along each diagonal of the sub-plots for counting suckers.

### Treatments

The whole plots treatments were:

1. Summer cropping—Sorghum (grain)
2. Winter cropping—Wheat.

Preparation for summer cropping involved an initial ploughing to about 10 cm with a heavy duty disc plough on 10 August 1968 followed by two further ploughings (20 September and 7 December) with a lighter disc plough. Sorghum was planted on 18 December at 5·5 kg $ha^{-1}$. Seed of green panic, buffel grass and lucerne (*Medicago sativa*), each at 1·1 kg $ha^{-1}$, was broadcast by hand 2 days later. On the same day, 30 mm of rain fell.

Plots for the winter crop were ploughed initially on 13 December 1968 to 10 cm with a heavy duty disc plough. The area was ploughed twice more (11 March and 23 May 1969) using a lighter disc plough. The ploughed ground was sown by hand on 23 May with the same pasture mixture as used with the summer crop and wheat was sown at 44 kg $ha^{-1}$ using a combine on the following day.

Rainfall was well below average during summer and autumn of 1968–69. From October 1968 to April 1969 only 300 mm of rain were recorded, compared with the expected average of 550 mm, and the sorghum crop, like all others on the Research Station, failed. Cattle were used to graze the crop and on 23 May 1969 the cattle were removed and the cropped area was broadcast with a mixture of buffel grass and green panic, each at 2·2 kg $ha^{-1}$.

The following methods and rates of application of 2,4,5-T ester were used for the sub-plot treatments:

1. Misting, using 0·56 kg acid equivalent (a.e.) 2,4,5-T $ha^{-1}$ in 45 litres of diesel distillate.
2. Boom spraying, using 1·12 kg a.e. 2,4,5-T $ha^{-1}$ in 110 litres of water.
3. Unsprayed control.

Previous trials (Johnson and Back 1977) indicated that 2,4,5-T at 0·56 kg $ha^{-1}$ in diesel distillate has approximately the same phytotoxicity as 1·12 kg $ha^{-1}$ in water.

The two chemical treatments were applied at three different times after planting the winter and summer crops, namely:

1. Summer crop (grazed—April 1969)
   (a) 20 May 69—22 weeks after sowing
   (b) 31 Jul 69—32 weeks after sowing
   (c) 15 Oct 69—43 weeks after sowing
2. Winter crop (harvested—22 September 1969)
   (a) 17 Oct 69—21 weeks after sowing
   (b) 25 Nov 69—27 weeks after sowing
   (c) 6 Jan 70—33 weeks after sowing

Brigalow is a summer growing perennial and the rate of emergence of regrowth following ploughing is slow during the winter period (Johnson and Back 1974). Therefore, the last spraying treatment following the summer crop was delayed until the late spring to ensure that most suckers had emerged.

**Sampling**

Counts of suckers in quadrats in the unsprayed control plots were made prior to ploughing and on the same day that each of the spraying treatments was imposed. Sucker densities were reduced so severely following winter cropping that the numbers of suckers in the permanent quadrats before spraying were too few for reliable results. Accordingly, the sampling technique was modified and two quadrats of varying size were established in each of the winter crop sub-plots with the aim of including at least 10 suckers in each quadrat. Suckers were counted in the sprayed sub-plots at the time of spraying.

Final sucker counts on the summer crop area were made on 19 and 20 May 1971, 19 months after the final spraying treatment; final counts on the winter crop area were made on 5 and 6 July 1971, 18 months after the final spray treatment.

Pasture on both summer and winter crop areas was sampled for yield on 4 March 1971. This followed a period of about 5 months during which time the experimental area remained ungrazed. Five 1 $m^2$ quadrats were harvested in three of the four replicates. The replicate not sampled was in a slight depression and was inundated following extremely high summer rainfall (297 mm in February 1971).

## III. RESULTS

In unsprayed plots the reduction in sucker density following winter cropping (89%) was markedly greater than the reduction following summer cropping (56%), though from the limited sampling the difference was not significant.

Results of post-harvest spraying are shown in table 1. The reduction in density following all treatments was very high and, of the main effects tested in the analysis of variance, only the comparison between misting and boom spraying showed any significance.

There was little difference due to the various times of spray application. Monitoring of sucker emergence on control plots during the spraying periods showed that sucker density in the summer-cropped plots remained relatively stable from the 22nd until the 43rd week but in some of the winter-cropped plots a substantial number of suckers died between the 21st and 33rd week. The percentage reductions shown in table 1 were calculated from "before" and "after" spraying counts so that these natural deaths which occurred after the 21st week would tend to exaggerate the effectiveness of the first and, to a lesser extent, the second spraying.

TABLE 1

PERCENTAGE REDUCTION IN DENSITY OF SUCKERS DUE TO POST-HARVEST SPRAYING WITH 2,4,5-T

| Method of Spraying | Summer Crop | | | Winter Crop | | |
|---|---|---|---|---|---|---|
| | Date of Spraying | Weeks After Sowing | Percentage Kill | Date of Spraying | Weeks After Sowing | Percentage Kill |
| Misting .. .. .. | 20 May 69 | 22 | 95·8 | 17 Oct 69 | 21 | 96·0 |
| | 31 Jul 69 | 32 | 91·9 | 25 Nov 69 | 27 | 95·3 |
| | 15 Oct 69 | 43 | 90·8 | 6 Jan 70 | 33 | 97·2 |
| | Mean | .. | 92·8 | .. | .. | 96·1 |
| Boom Spraying .. .. | 20 May 69 | 22 | 82·8 | 17 Oct 69 | 21 | 95·7 |
| | 31 Jul 69 | 32 | 93·0 | 25 Nov 69 | 27 | 89·5 |
| | 15 Oct 69 | 43 | 79·0 | 6 Jan 70 | 33 | 87·2 |
| | Mean | .. | 85·2 | .. | .. | 90·8 |
| Necessary Differences for Significance 5% | .. | .. | 13·5 | .. | .. | 13·3 |
| | .. | .. | 7·8 | .. | .. | 7·7 |
| 1% | .. | .. | 19·3 | .. | .. | 18·9 |
| | .. | .. | 11·2 | .. | .. | 10·9 |

The combined effect of cropping and spraying reduced sucker densities by 95% and 99% following summer and winter cropping respectively. These differences were not significant.

Pasture yields are given in table 2. Data were too few for statistical analysis but following both winter and summer cropping highly productive improved pastures were established. The pasture established after the winter crop tended to have a higher yield of sown grasses and less native grass and forbs than that established after the summer crop. Seedling lucerne plants were common in the early establishment phase but did not persist even in the unsprayed control plots.

**TABLE 2**

PASTURE YIELD TWO YEARS AFTER SOWING
(airdry weights as kg $ha^{-1}$)

| Treatment | Sown Grass | Lucerne | Native Grass | Native Forbs |
|---|---|---|---|---|
| Summer crop .. .. | 7 690 | .. | 1 630 | 1 240 |
| Winter crop .. .. | 11 440 | 19 | 1 090 | 470 |

## IV. DISCUSSION

A single annual cropping combined with pasture establishment and followed by post-harvest spraying of brigalow regrowth converted an area of dense suckers into a sown pasture relatively free of suckers.

The greater control of brigalow suckers in the unsprayed winter crop than in the unsprayed summer crop supports earlier findings (Johnson 1964; Johnson and Back 1973) that ploughing in the summer-autumn period is more effective than ploughing in the winter-spring period.

The reduction in density following spraying in the summer after harvesting the winter crop was only marginally greater than that following winter-spring spraying after summer cropping. Rainfall was above average before the summer spraying and below average before the winter spraying. Based on a mixed sample of brigalow trees and suckers of varying sizes, Johnson (1964) suggested that the effectiveness of spraying increased with increasing soil moisture. This was confirmed by Johnson and Back (1974) in an experiment involving 3-year-old suckers. Results of the present trial indicate that suckers in their first season of growth are very susceptible irrespective of the moisture content of the soil. This supports similar conclusions drawn following the spraying during a drought in May 1965 of 8 000 ha of regrowth following pulling and burning on ten properties in Arcadia Valley, north of Injune, when a mean kill of 80% was achieved (Johnson unpublished data).

If the mean reduction following cropping is combined with the mean reduction following spraying, the winter cropping system appeared only marginally better with 1% of the suckers remaining compared with 5% following summer cropping and spraying. These differences were not significant. Both systems gave excellent control. These results appear little inferior to those following 3 years of annual cropping.

The time between ploughing and spraying should be sufficient to allow all regrowth to emerge. Johnson and Back (1974) showed that, following ploughing in December, most suckers emerged within 22 weeks. This was confirmed in this experiment by observations on the control plots. With late planting (after the end of December) Johnson and Back (1974) indicated that maximum emergence of suckers can be delayed until early spring. Under these circumstances spraying should be deferred until spring to allow the slower growing suckers to emerge.

With winter cropping maximum emergence occurred prior to the first spraying in mid-October. Few suckers emerge during the winter (Johnson and Back 1974) but the rate of emergence increases into the spring particularly if soil moisture is high. During this experiment 117 mm of rain fell in October, approximately twice the expected average for the month, while rainfall in both November and December was slightly above average. The rain which commenced on 1 October could have caused the rapid emergence of suckers. Results from other experiments indicate that maximum emergence under average to below average rainfall can be delayed until November or December. In practice it would be advisable to delay spraying until November-December in years of sparse, early spring rainfall.

In both crops all the suckers had emerged at the time of the initial spraying so that any difference in effectiveness among the three times of treatment was not influenced by percentage emergence. In fact, no trend in effectiveness was noted with an increase in the delay between maximum emergence and spraying.

The average reduction following misting (94·5%) was significantly better than that following boom spraying (88%). This comparison was confounded by a difference in the spray mixture, 0·56 kg ha$^{-1}$ 2,4,5-T in 45 litres of distillate for low volume misting and 1·12 kg ha$^{-1}$ 2,4,5-T in 110 litres water for boom spraying. As both methods of application involved the use of special experimental equipment and techniques the comparison has limited practical value. However, results following either method were very satisfactory.

Though the yield of sown species appeared greater in the pasture sown with the wheat crop, the two pastures are not strictly comparable. Although soil moisture was high at the time of the summer sowing, the pasture, which initially established, experienced 5 months of well below average rainfall and a period of heavy grazing. When the area was resown by hand following grazing the surface soil was more compacted than at the time of the initial sowing and this did not favour easy establishment. The winter sown pastures were established under slightly more favourable weather conditions and in the absence of grazing. The higher yield of native grass and forbs in the summer sown pasture could be attributed partly to the effects of grazing. Selective grazing of the more palatable sown species and the delay, following grazing, before the sown grasses had become re-established could have allowed more native species to persist. Even so, the resultant pasture was very satisfactory.

The crop stubble left after either harvesting or grazing did not obstruct the spraying operation.

## V. ACKNOWLEDGEMENT

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## REFERENCES

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*). *Aust. J. exp. Agric. Anim. Husb.* 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*). Qd J. agric. Anim. Sci. 30:199-211.

JOHNSON, R. W. AND BACK, P. V. (1974).—Control of brigalow (*Acacia harpophylla*) regrowth by single and double ploughings. *Qd J. agric. Anim. Sci.* 31:1-11.

JOHNSON, R. W. AND BACK, P. V. (1977).—The relationship between burning and spraying in the control of brigalow (*Acacia harpophylla*) regrowth. I Burning as a pre-spraying treatment. *Qd J. agric. Anim. Sci.* 34:179-187.

WEBB, A. A. (1970).—Soil survey of Brigalow Research Station. *Brigalow Research Station Soil and Vegetation Surveys* (Queensland Department of Primary Industries—Brisbane).

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