QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

DIVISION OF PLANT INDUSTRY BULLETIN No. 764

RELATIONSHIP BETWEEN BURNING AND SPRAYING IN THE CONTROL OF BRIGALOW (ACACIA HARPOPHYLLA) REGROWTH

II. BURNING AS A POST-SPRAYING TREATMENT

By R. W. JOHNSON, M.Sc., Ph.D. AND P. V. BACK, Q.D.A.

SUMMARY

Burning at various times from 6 to 26 months after spraying brigalow suckers with 2,4,5–T did not reduce the effectiveness of the spray treatment. Kills following spraying plus burning were consistently better than kills following spraying alone. Best results were achieved when burning was undertaken in the summer-autumn period. After the initial spraying in February 1968 best kills occurred when burning was delayed for 11 months and 26 months after treatment.

I. INTRODUCTION

In the first paper in this series it was shown that regrowth after a pasture burn was more susceptible to overall spraying with 2,4,5-T than the unburnt suckers. This paper is concerned with the effect of fire after spraying.

Burning both intentional and accidental is a common feature of the environment of brigalow country. When ringbarking was the method used for clearing brigalow, it was generally believed that fire should be excluded from the treated area for at least 4 years. Earlier burning was often accompanied by prolific root suckering (Johnson 1964). Because of this previous experience, it was suggested that sprayed areas should be left unburnt for 3 to 4 years after treatment. Wetherall (unpublished data, 1966), following the burning of his sprayed trial plots, stated that burning within 2 years of spraying reduced the effectiveness of spraying. However, this had to be a subjective judgment as all plots were burnt and he was not able to compare his results with those from unburnt plots.

The fear of accidental burning of sprayed areas is widespread throughout many cattle producing areas in Central Queensland and has deterred some graziers from spraying.

Regrowth of brigalow following a pasture burn is dependent on sufficient food reserves being present in the root system for establishment. It could therefore be argued that burning at a time when food reserves were low could substantially reduce the sucker population. Survival of brigalow suckers following spraying often depends on the production of coppice shoots and root suckers and burning this young regrowth which had drawn on stored food reserves might even enhance the effectiveness of spraying. Yet it is also known that burning can stimulate root suckering (Johnson 1964).

This paper reports an experiment designed to obtain more precise information of the effect of burning on the results obtained following the spraying of brigalow suckers.

II. MATERIALS AND METHODS

Site

The experiment was conducted on the Brigalow Research Station about 32 km north-west of Theodore. The average annual rainfall is approximately 700 mm, two-thirds of which falls from November to March.

The experimental area was originally covered by a brigalow-wilga (*Geijera parviflora*) forest (Johnson 1970). The soil is a greyish-brown uniform cracking clay (Northcote Ug5.24, Ug5.25) with occasional melonholes. The forest was pulled to the ground in October 1963, burnt in December 1963 and the area sown to a mixture of Rhodes grass (*Chloris gayana*), green Panic (*Panicum maximum* var. *trichoglume*) and buffel grass (*Cenchrus ciliaris* cv. Biloela). The area was stickraked in March 1967.

At the commencement of the trial in January 1968 the brigalow suckers were 30 to 100 cm tall and growing at a mean density of about 25 000 per hectare.

Treatments

Ten treatments as set out below were applied to plots laid out in a randomized block with four replicates.

T1. Sprayed 26 Jan 1968—Burnt on 25 Jul 1968
T2. Sprayed 26 Jan 1968—Burnt on 8 Oct 1968
T3. Sprayed 26 Jan 1968—Burnt on 21 Dec 1968
T4. Sprayed 26 Jan 1968—Burnt on 23 Apr 1969
T5. Sprayed 26 Jan 1968—Burnt on 31 Jul 1969
T6. Sprayed 26 Jan 1968—Burnt on 30 Sep 1969
T7. Sprayed 26 Jan 1968—Burnt on 5 Jan 1970
T8. Sprayed 26 Jan 1968—Burnt on 26 Mar 1970
T9. Spray Control—Sprayed 26 Jan 1968—Unburnt
T10. Control—Unsprayed—Unburnt

Plots were 17 m x 17 m and each was surrounded by a 3 m wide firebreak which was maintained by regular ploughing. Two fixed quadrats, 10 m x 1·5 m, were established in each plot.

Spraying and Burning Techniques

All spray treatments were applied on 26 January 1968. Mixed butyl and isobutyl esters of 2,4,5-T were applied at 1·1 kg acid equivalent ha^{-1} in 56 litres of diesel distillate. The chemical was distributed with a knapsack misting machine using a technique designed to simulate some of the features of aerial spraying or tractor mounted misting. The spray was directed downwards from above the suckers along premarked swathes each 3·3 m wide while travelling at a speed of approximately 3 km h^{-1}. The spraying operation, which lasted 2 h, was carried out before 10 a.m. under still air conditions. In the 6 weeks prior to spraying 224 mm of rain was recorded, the soil was moist and the suckers were growing vigorously.

Treatments were burning at different times after spraying and, after the initial burn in July 1968, it was aimed to burn four plots at a minimum of 2-monthly intervals on days when conditions were considered suitable, viz., hot, dry, cloudless days following at least a short period of dry weather. Wheat straw was added to plots carrying less than average grass fuel to ensure that all plots were completely burnt. Burning took place between 1.00 p.m. and 3.00 p.m. and each plot took from 5 to 10 min to burn after lighting up all four sides.

Cattle were excluded from the trial area until the completion of the trial in March 1972.

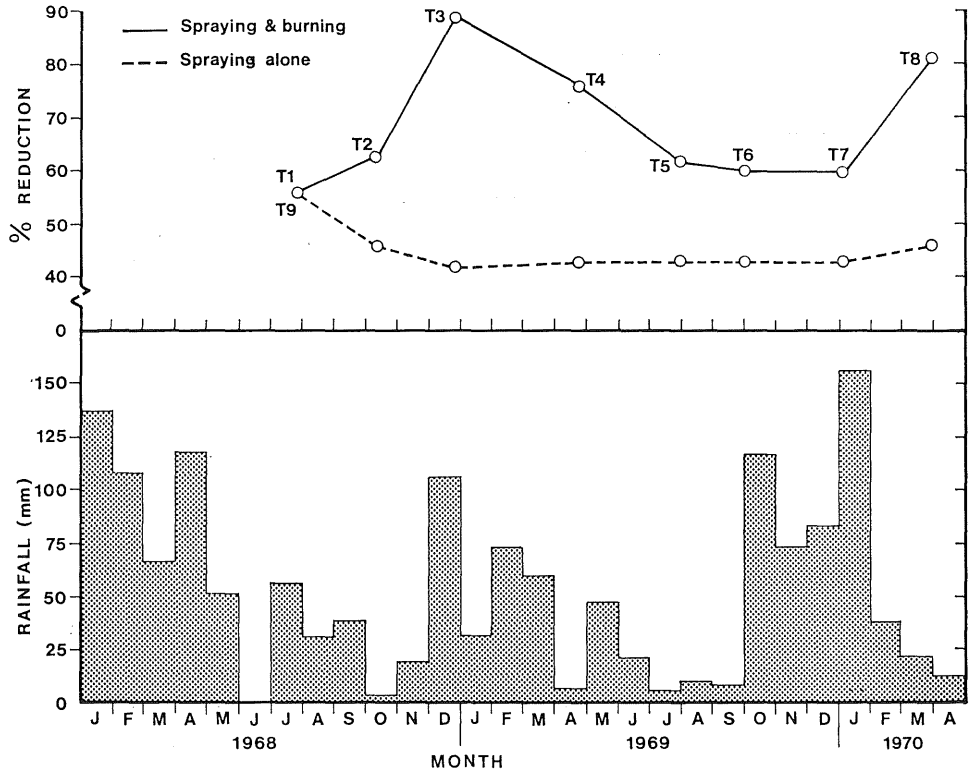

Figure 1. Rainfall and adjusted percentage reduction at different treatment times.

Data Collection and Analysis

Suckers were counted in the fixed quadrats in January 1968 before the initial spraying. Suckers, in those plots about to be burnt, were recounted and at the same time counts were also made of suckers in the sprayed control plot. Final counts were made approximately 18 months after burning. Stems of brigalow suckers were counted as individuals when 10 cm or more from their nearest neighbour. Groups of stems less than 10 cm apart were counted as one.

Daily rainfall was recorded on a site adjacent to the trial area.

Percentage kill data were analysed untransformed and using an inverse sine transformation.

III. RESULTS

Results of the monitoring of sucker densities in fixed quadrats in the sprayed but unburnt plots (T.9) are given in figure 1. This shows that maximum regrowth on these plots was recorded in December 1968 approximately 11 months after spraying. At the time of the first burn only 80% of this regrowth had appeared.

Spraying followed by burning in December 1968 (11 months after misting), April 1969 (15 months), July 1969 (18 months) and March 1970 (26 months) resulted in kills which were significantly better than that achieved by spraying alone (table 1). Best kills resulted from the burns in December 1968 and March 1970. Burning at these times gave significantly better kills than burning in July 1968, October 1968 and September 1969.

TABLE 1

PERCENTAGE KILL FOLLOWING SPRAYING AND BURNING

Treatment No.	Date of Burn	Delay (Months)	Final Kill (%)	Adjusted Kill (%)
1	25 Jul 68	6	59·3 (0·879)*	56·2 (0·848)
2	8 Oct 68	9	59·2 (0·877)	63·1 (0·913)
3	21 Dec 68	11	85·6 (1·181)	89·1 (1·234)
4	23 Apr 69	15	71·5 (1·007)	76·1 (1·059)
5	31 Jul 69	18	72·3 (1·016)	62·5 (0·911)
6	30 Sep 69	20	54·5 (0·830)	59·7 (0·883)
7	5 Jan 70	24	65·3 (0·941)	60·1 (0·887)
8	26 Mar 70	26	87·8 (1·213)	81·5 (1·127)
9	unburnt	..	38·0 (0·664)	45·7 (0·742)
Necessary differences for significance			5% (0·282) 1% (0·382)	5% (0·169) 1% (0·230)

( )* — Inverse sine transformation used for analysis.

TABLE 2

EFFECT OF SPRAYING ON PLOTS USED FOR VARIOUS BURNING TREATMENTS

Treatment No.	Date of Burn	Kill at Time of Burning (%)	Expected Kill (%)
1	25 Jul 68	60·5	56·4 (0·849)*
2	8 Oct 68	42·3	44·3 (0·729)
3	21 Dec 68	44·3	42·2 (0·707)
4	23 Apr 69	38·0	42·3 (0·708)
5	31 Jul 69	66·1	68·5 (0·975)
6	30 Sep 69	44·0	42·4 (0·709)
7	5 Jan 70	55·8	60·2 (0·889)
8	26 Mar 70	60·6	65·6 (0·944)
9	unburnt	..	38·0 (0·664)
Necessary differences for significance	5%	..	(0·388)
	1%	..	(0·525)

( )* — Inverse sine transformation used for analysis.

These results reflect the kills achieved firstly from the spraying treatment alone and secondly from the subsequent burning treatment. By monitoring the rate of kill and regeneration of the sprayed and unburnt suckers it is possible to predict, from the pre-burning counts of the various burning treatments, the eventual kill which would have resulted if no burning had been applied (table 2). These predicted values varied considerably among treatments with a range of kills from about 38% to 68%. As all plots had undergone similar spraying treatments it is not surprising that the treatment means were not significantly different. However it is obvious that in assessing the combined effect of spraying plus burning, treatments 5, 7 and 8 were favoured due to the better initial kills following spraying.

Using these predicted kills as covariates the data were reanalysed and results are given in table 1. The kills from spraying plus burning, adjusted for variations in the predicted initial kill, vary from the unadjusted kills shown in table 1. Spraying plus burning in October 1968 (9 months after spraying) is now shown to be significantly better than the spraying without burning controls, while results from spraying plus burning in July 1969 (18 months after spraying) are not. These results show more precisely the effectiveness of the burning treatment than do the actual kills recorded in table 1.

TABLE 3

PERCENTAGE KILL DUE TO BURNING ALONE

Treatment No.	Date of Burn	Actual Kill (%)	Expected Kill (%)
1	25 Jul 68	−7·1 (- - -)	8·1 (0·288)*
2	8 Oct 68	28·9 (0·568)	25·5 (0·529)
3	21 Dec 68	71·8 (1·011)	75·0 (1·047)
4	23 Apr 69	52·8 (0·814)	48·6 (0·772)
5	31 Jul 69	11·0 (0·337)	8·0 (0·287)
6	30 Sep 69	8·3 (0·291)	4·8 (0·221)
7	5 Jan 70	10·6 (0·331)	7·3 (0·273)
8	26 Mar 70	59·8 (0·884)	63·0 (0·917)
Necessary differences for Significance { 5%		(0·438)	(0·450)
1%		(0·600)	(0·613)

( )* — Inverse sine transformation used for analysis.

The effectiveness of the burning treatment alone was also assessed by analysing the data using pre-burn counts and final counts (table 3). For this analysis results from the first burn in July, 1968 (6 months after spraying) were omitted as it was felt the burn was imposed too soon after spraying and the results were confounded by continuing chemical action.

Burning in December 1968 (11 months after spraying) gave the best increase in kill being significantly better than burning at all other times except April 1968 (15 months after spraying) and March 1970 (26 months after spraying).

A further assessment of the effectiveness of the burning treatment alone (table 3) was made by equating the kill due to burning with the difference between the expected kill following spraying (table 2) and the actual kill following spraying and burning (table 1). Though this analysis altered the mean percentage kills for the treatments it did not reveal any more significance.

IV. DISCUSSION

No evidence was obtained in this experiment to suggest that burning 6 to 26 months after spraying reduces the effectiveness of spraying. Burning during the summer and autumn in the first and second years after spraying significantly improved the kill, while burning in the winter and spring had little effect. This pattern is similar to that shown by Johnson and Back (1973) when studying the effect of grass fires on the density of brigalow regrowth.

The effect of a good pasture burn on brigalow suckers is firstly to kill all leaves (phyllodes) and secondly, depending on the intensity of the fire, to kill the stems down to ground level. Regrowth following burning is mainly from the butt or from living stems; root suckering at a distance from the parent plants is not common (Johnson and Back 1973). This new regrowth from roots and stems can only occur at the expense of reserve food material.

The pattern of regeneration following spraying indicated that the initiation of regrowth continued until about December 1968, 11 months after spraying. The improvement in kill due to burning from July 1968 to December 1968 could be attributed to declining food reserves and the decrease from December to September 1969 to a build up in reserves during the late summer and autumn of 1969.

If results were dependent only on the timing of the burn in relation to the pattern of regeneration following spraying kills would be expected to stabilize after the winter of 1969. However in March 1970, kills following burning were approximately equal to those achieved 11 months after spraying. This suggests an influence of seasonal conditions on the effectiveness of the burn.

Johnson and Back (1973) measured changes in density of brigalow suckers after burning at different times over a period of 14 months. They found that reductions in density were more likely to occur when burning was undertaken in the summer. If soil moisture is adequate shoot growth reaches a peak in the January–March period and reductions in density following burning in this period appear to be correlated with growth. In this experiment the combined effects of the spraying in the previous year and the timing of the burn could have been responsible for the good kills following the burn in March 1970. However the much lower effectiveness of the burn in January 1970 is difficult to explain.

Results indicate that burning up to 26 months after treatment is not likely to reduce the effectiveness of spraying. If the kill following spraying is satisfactory it is probably more profitable to leave the sprayed area unburnt and to make effective use of the increase in pasture production. However, if regrowth is common following spraying, burning during the first or second summer or autumn is likely to kill many of the suckers and improve the final kill. Depending on the results following burning, consideration may then have to be given to the need for a second spraying.

In practice the likelihood of being able to burn during the first summer or autumn after treatment will depend on the residual state of the pasture at the time of spraying, seasonal conditions following spraying and on grazing intensity. If sown grass is still common and seasonal conditions following spraying are average or better, burning could be undertaken during the first summer or autumn. If the pasture stand is sparse at spraying then two seasons would generally be required for effective burning.

V. ACKNOWLEDGEMENTS

We are indebted to the officers and staff of the Brigalow Research Station who made the experimental site available and provided machinery and labour. We are also grateful to Miss E. Goward, Biometry Branch, for the statistical analysis.

REFERENCES

JOHNSON, R. W. (1964).—'Ecology and Control of Brigalow in Queensland.' (Qd Dept. of Primary Industries: Brisbane).

JOHNSON, R. W. (1970).—Vegetation Survey of Brigalow Research Station. *In* Brigalow Research Station Soil and Vegetation Surveys (Qd Dept. 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.

(Received for publication 4 January 1977)

Dr Johnson is Director, Botany Branch, Queensland Department of Primary Industries, and is stationed at Indooroopilly, Brisbane. Mr Back was an experimentalist in the Department's Agriculture Branch stationed at Rockhampton.