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EFFECT OF METHOD OF ESTABLISHMENT OF TOWNSVILLE STYLO AND APPLICATION OF SUPERPHOSPHATE ON THE GROWTH OF STEERS

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SUMMARY

In a grazing experiment in central coastal Queensland two methods of introducing Townsville stylo (*Stylosanthes humilis*) into native black spear grass (*Heteropogon contortus*) pasture were compared. Both allowed the stocking rate to be increased from a normal 1 beast to 8 ac to 1 beast to 4 ac without impairing steer growth rate. When superphosphate was applied steer growth rate was considerably improved.

Two groups of Brahman cross steers each grazed the trial pastures for 2 years and in both instances the steers from the superphosphate-treated paddocks with Townsville stylo were appreciably better grown and four times as many were "finished" for market at 2½ years of age. The levels of production achieved per acre over the 4 years were 2½ times that of native pasture, i.e. 76 lb/ac as against 30 lb. The two areas of Townsville stylo not treated with superphosphate gave 57 lb and 56 lb per ac.

There was no appreciable difference in production between introducing Townsville stylo by complete cultivation and introducing it by the contour strip method where only one-quarter of the area is disturbed. The latter was a far cheaper method.

I. INTRODUCTION

A major problem in the coastal areas of central Queensland, where black spear grass (*Heteropogon contortus*) is the dominant native pasture species, is the poor quality of the forage available for much of the year. This is reflected in the long period taken by animals to reach a marketable weight and in the severe stresses imposed at times on breeding stock.

The value of Townsville stylo (*Stylosanthes humilis*) as a legume for introduction into black spear grass pastures has been demonstrated (e.g. Shaw 1961). It has been shown that the legume can be introduced into these pastures simply and at relatively low cost. For coastal conditions, Graham (1963) recommended contour cultivated strips widely spaced over the paddock from which the legume would spread. For somewhat drier conditions, Strachan, Lamberth and Finlay (1967) suggested complete cultivation and seeding to achieve a full stand of the legume immediately.

The present paper reports a comparison of different methods of establishing Townsville stylo in black spear grass pastures using grazing animals to assess the effectiveness of each method.

II. MATERIALS AND METHODS

The study was carried out at "Lowville", 10 miles south of Marlborough, central Queensland. This property is located in the black spear grass region (Shaw and Bisset 1955). Average annual rainfall at Marlborough is 32 in., with a range from 20 in. to 50 in. The experimental area has been described in detail by Graham and Stubbs (1966). Essentially, the trial was located on undulating, slightly acid, texture contrast soils, derived from granite. Available phosphorus levels were low (4 p.p.m.). The area was originally dominated by narrow-leaved ironbark (*Eucalyptus crebra*).

The treatments were:

1. *Native pasture.*—A stand of black spear grass in which most of the timber had been ringbarked some years previously.
2. *Contour strip.*—Townsville stylo sown on contour cultivated strips in otherwise undisturbed native pasture. The strips were worked once with a chisel plough. They were 8 ft wide and approximately half a chain apart (centre to centre), so only one-quarter of the area of these paddocks was cultivated and sown.
3. *Complete cultivation.*—Townsville stylo sown over the whole paddock following a complete cultivation with the chisel plough.
4. *Superphosphate.*—Townsville stylo sown following complete cultivation as in treatment 3, and superphosphate with ·06% molybdenum applied at the rate of 2 cwt/ac at seeding followed by 1 cwt/ac superphosphate annually.

The design was a randomized block with two replications.

The native pasture paddocks (88 ac each) occupied double the area used for the treated paddocks (44 ac). The experimental area totalled 440 ac. The fallen timber was raked and burnt in the complete cultivation paddocks (treatments 3 and 4) and along the lines to be cultivated in the contour strip paddocks. It was untouched in the native pasture paddocks. The cultivation used was a single working with a chisel plough during January–February 1964. Townsville stylo seed at 3 lb/ac was broadcast through a rotary fertilizer spreader immediately following cultivation. The initial superphosphate application was also made at this time. The annual top-dressings were applied in October–November of the years 1964–1968 (inclusive).

Prior to the commencement of experimental grazing the area was bulk-grazed by station cattle while fencing and watering facilities were being completed.

Fourteen crossbred Brahman steers aged from 10 to 12 months and of an average liveweight of 484 lb were placed in each paddock on November 16, 1964. They were weighed at irregular intervals when being dipped over the next 2 years. The number of animals per paddock was reduced to 11 on April 22, 1965.

It had been intended that each group of animals remain on their respective treatments for 2 years, but because of severe drought all group 1 animals were removed from the trial from August 26 to December 23 in 1965. During this period, they ran together under poor range conditions and lost from 0·65 lb to 0·91 lb liveweight per day.

On August 16, 1966, this phase of the experiment was terminated and the animals were individually appraised for market value by the senior livestock buyer for a large central Queensland meatworks. Only those steers considered fully "finished" were actually sold. The remainder were returned to the station herd for fattening in the next year.

A further draft of crossbred Brahman steers was placed on the experiment on October 25, 1966. These were 10–12 months of age and had been weaned 3 weeks previously and fed lucerne hay in small paddocks. On entering the experiment they averaged 493 lb/head liveweight. Again 11 steers were used in each paddock. Except for periodic dipping and weighing they remained continuously on the experiment until it terminated on August 16, 1968.

To assess the rate of spread of Townsville stylo from the cultivated strips, 20 permanent transects each of 50 links were established at random in each paddock of this treatment. The transects were centred on cultivated and sown strips and ran at right-angles to them. Townsville stylo plants were counted in a 1 link x 1 link quadrat every 10 links along each transect. Counts were made on March 7, 1966, May 4, 1967, and June 28, 1968.

In August 1965, when the animals were removed from the experiment, estimates were made of the quantity and quality of forage available to them by harvesting samples from each treatment. Faecal samples from randomly selected animals were also taken and those from within each treatment were bulked for analyses.

III. RESULTS

Animal performance.—During the drought year of 1965 there was little difference in liveweight gain per head due to pasture treatments (Figure 1), although the native pasture and superphosphate groups were slightly heavier when removed in August. On a daily gain per head basis this difference was highly significant (Table 2). During the second year a major and highly significant response to superphosphate was obtained despite a highly significant treatment x block interaction (Table 1).

TABLE 1

ANALYSIS OF VARIANCE: ON ABSOLUTE DAILY LIVEWEIGHT GAINS EACH YEAR

Significance of F ratios for treatments, blocks and treatment block interaction

—	Year 1	Year 2	Year 3	Year 4
Treatments (T) ..	**	**	**	..
Blocks (B)	..	**	..	..
T × B	..	**	..	**

** $P < 0{\cdot}01$.

In 1967 liveweight gain per head showed a highly significant response to superphosphate, while complete cultivation significantly depressed it below that obtained from the native pasture treatment. In the final year the previous year's advantage from the superphosphate applications was maintained but there were no strong differences between animals on different treatments. On this occasion the treatment x blocks interaction was again highly significant (Tables 1 and 2), masking the very weak treatment effects.

TABLE 2

DAILY AND (IN PARENTHESIS) PERIOD LIVEWEIGHT GAINS PER HEAD AND PER ACRE FOR THE TWO GROUPS OF CATTLE, WITH TOTALS FOR EACH AND BOTH GROUPS

—	Animal Group 1			Animal Group 2			Grand Total Years 1–4
	Year 1 1964–65	Year 2 1965–66	Total Years 1 and 2	Year 3 1966–67	Year 4 1967–68	Total Years 3 and 4	
DAILY LIVEWEIGHT GAIN/HEAD (LB)							
Native pasture	0·675 (191)	1·197 (279) *	(470)	0·831 (272)	0·751 (248) †	(520)	(990)
Contour strip	0·460 (130)	1·216 (283)	(413)	0·764 (252)	0·770 (254)	(506)	(919)
Complete cultivation	0·507 (144)	1·216 (283)	(427)	0·713 (236)	0·687 (226)	(462)	(889)
Superphosphate	0·641 (182)	1·967 (458)	(640)	0·990 (326)	0·745 (246)	(572)	(1212)
L.S.D. 5%	0·084	0·108	..	0·079	0·074	..	..
L.S.D. 1%	0·111	0·143	..	0·105	0·098	..	..
DAILY LIVEWEIGHT GAIN/ACRE (LB)							
Native pasture	0·084 (24)	0·150 (35)	(59)	0·104 (34)	0·094 (31)	(65)	(124)
Contour strip	0·115 (32)	0·304 (71)	(103)	0·191 (63)	0·192 (64)	(127)	(230)
Complete cultivation	0·127 (36)	0·304 (71)	(107)	0·178 (59)	0·172 (57)	(116)	(223)
Superphosphate	0·160 (45)	0·492 (115)	(160)	0·247 (82)	0·186 (62)	(144)	(304)
L.S.D. 5%	0·021	0·027	..	0·020	0·018	..	..
L.S.D. 1%	0·028	0·036	..	0·026	0·024	..	..
Length of Period (Days)	283	233	..	330	331	..	..

* Interactions for Daily Liveweight Gain/Head, Year 2.

Block	Native Pasture	Contour Strip	Complete Cultivation	Superphosphate
1	1·257	1·449	1·323	2·039
2	1·136	0·983	1·111	1·894

L.S.D. 5% = 0·152, 1% = 0·202

† Interactions for Daily Liveweight Gain/Head, Year 4

Block	Native Pasture	Contour Strip	Complete Cultivation	Superphosphate
1	0·701	0·836	0·618	0·785
2	0·801	0·703	0·757	0·705

L.S.D. 5% = 0·104, 1% = 0·138

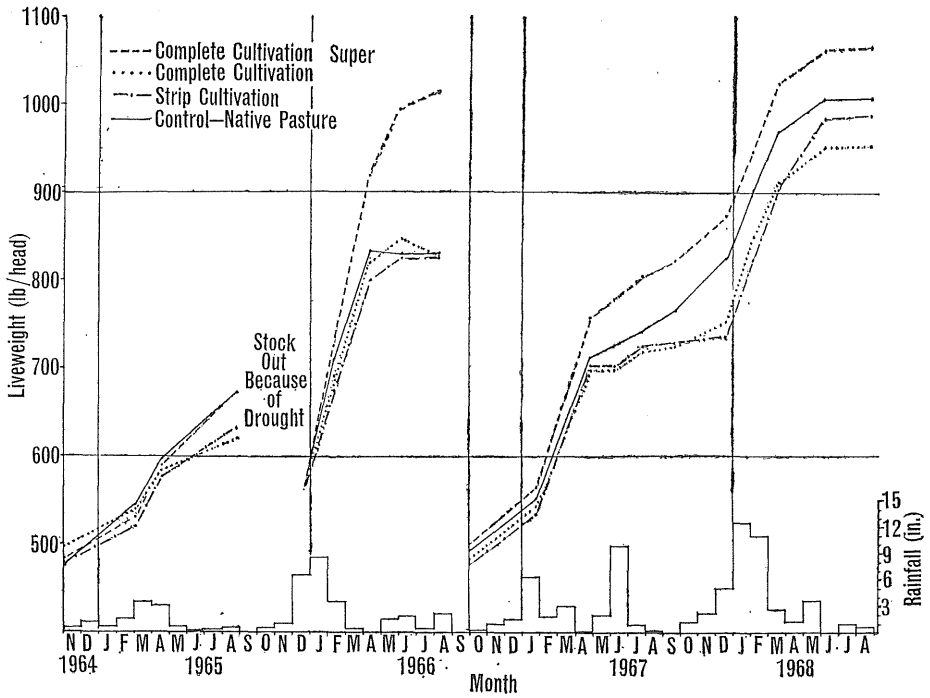

Fig. 1.—Changes in mean liveweights of each group of steers over the period of grazing, together with rainfall data.

The outstanding livestock performance on a per acre basis was from superphosphate in year 2 (115 lb liveweight gain per acre). In 2 years out of four (year 1, year 4) native pasture showed very good individual animal performance but the performance per acre was much poorer. For animals on contour strip treatments performance was similar to that of those on complete cultivation paddocks.

TABLE 3

MEAN ESTIMATES OF MARKET VALUE OF GROUP 1 STEERS AT 2½ YEARS OF AGE

Treatment	Assessed Market Value per Head
	$
Superphosphate	120.00
Complete cultivation ..	92.94
Contour strips	86.88
Native pasture	80.84

The cattle on the superphosphate treatments had a higher market value than the other animals in the first group when these were finally removed (Table 3). This is substantiated by the fact that of the 22 steers considered marketable by the owner and sold at this stage, 20 came from the superphosphate paddocks.

Spread of Townsville stylo.—The rapid spread of the legume stand from the cultivated strips during 1967 and 1968 is shown in Table 4. Two years after sowing, scattered plants existed throughout the inter-strip space but these remained sparse until the fourth year.

TABLE 4

SPREAD OF TOWNSVILLE STYLO FROM STRIPS TO ADJOINING NATIVE PASTURE
Mean plants per sq lk

Date	Distance from Centre of Cultivated Strip (links)					
	Up Hill		On Strip		Down Hill	
	25	15	5	5	15	25
7.iii.66	0·4	0·1	3·3	5·5	1·2	1·2
4.v.67	2·0	1·7	4·0	8·2	4·3	4·3
28.vi.68	6·0	5·8	10·9	14·1	10·4	13·2

IV. DISCUSSION

The outstanding effect achieved was from the application of superphosphate, but this did not show up in all years. During the drought year 1964-65, there was little apparent effect on a per head basis, while in the exceptionally wet summer of 1967-68 there was again no outstanding difference due to superphosphate on either a per head or a per acre basis.

The slightly higher forage availability in the native pasture and strip-treated paddocks following removal of the animals in August 1965 (Table 5) could be put down to less disturbance by the recent (February 1964) cultivation and to better utilization of the feed available on the superphosphate paddocks. The forage and faecal samples showed sub-maintenance dietary protein and phosphate in all groups.

TABLE 5

YIELD OF FORAGE ON OFFER WITH CRUDE PROTEIN AND PHOSPHORUS CONTENT, AND FAECAL CRUDE PROTEIN CONTENT FOR THE DIFFERENT TREATMENTS ON 26.viii.65 WHEN CATTLE WERE REMOVED BECAUSE OF DROUGHT

Treatment	Native Pasture	Contour Strip	Complete Cultivation	Superphosphate
Pasture oven-dry weight (lb/ac)	128	112	53	52
Pasture crude protein (%)	5·8	5·4	5·1	6·3
Pasture phosphorus (%)	0·04	0·08	0·06	0·11
Faecal crude protein (%)	7·7	9·1	9·0	8·4

During 1965 all animals were receiving barely sufficient feed to maintain slow growth, and this was exhausted by August, when they were removed. In 1968 there was sufficient pasture growth in all treatments for all steers to select an adequate diet.

It should be realized that the steers on native pasture at all times had access to twice the area per head as that available to animals on Townsville stylo pastures. This was why, in 1965, the animals on native pasture performed better than those on both Townsville stylo treatments not top-dressed with superphosphate.

In seasons of median rainfall (1965-66 and 1966-67), the animals on the superphosphate treatment performed much better than all others. On the other hand, in the drought year (1964-65) they suffered from a shortage of feed, although not as much as those on other Townsville stylo treatments; and in the wet year (1967-68) the advantages of the superphosphate application were masked by the high selectivity available at the lower stocking rate on native pasture. In that year the stocking rates of all treatments could have been substantially increased, probably more so in the superphosphate-treated paddocks.

A native pasture stocking rate of a beast to 10 ac was considered normal on this property for well-grown animals. With the smaller animals used in this experiment, a beast to 8 ac could be considered the normal equivalent.

There was little difference between the performance of animals on the contour strip planted Townsville stylo and the completely cultivated and sown paddocks where superphosphate was not applied, even in the first 2 years. It is interesting to speculate what may have happened if the fencing and watering facilities had been available to receive experimental animals in February 1964 and no drought had occurred in 1965. This experiment does not clarify the position for the first year and a-half. By the second year Townsville stylo was beginning to spread away from the strips and by the third year it was fairly well established over the whole paddock. Experimental grazing did not commence until 9 months after the legume was planted.

To have been of economic value, very substantial differences in favour of complete cultivation would have been required. The costs of establishing the Townsville stylo by each method were recorded at "Lowville" and are presented in Table 6.

TABLE 6

ESTIMATED COSTS FOR ESTABLISHING TOWNSVILLE STYLO BASED PASTURES BY THREE METHODS AT "LOWVILLE", MARLBOROUGH, DURING 1964

$/ac

Treatment	Contour Strip*	Complete Cultivation	Superphosphate
	$	$	$
Fuel oil and labour	0.15	0.60	0.60
Rotary broadcasting	0.08	0.30	0.30
Tractor maintenance and depreciation	0.50	2.00	2.00
2 cwt. superphosphate at $2/cwt	..	..	4.00
3 lb Townsville stylo seed at 70c per lb	0.52	2.10	2.10
Total cost per acre	$1.25	$5.00	$9.00

* Actual cultivated area costs as for complete area but only one-quarter area treated.

No attempt is made here to explain the economic implications of the results. It is readily apparent, however, that in this particular environment there was no advantage from complete cultivation when compared with the contour strip method of introducing Townsville stylo into native black spear grass areas.

It is not clear whether the major improvement in steer performance in some years from the use of superphosphate was by way of better legume and other pasture production or purely an effect of improved dietary phosphorus. The fact remains, however, that not only were these animals better grown when the first

group was removed but there was a much higher proportion of the animals from the superphosphate plots considered to be ready for market. All other animals had to be carried through for a further season before they could be marketed.

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