TOWNSVILLE STYLO RESEARCH AT SWAN'S LAGOON

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ABSTRACT

Townsville stylo can be established quite readily by aerial seeding on to the surface of burned country on the low phosphate solodic soils in the Burdekin. Heavy stocking should be employed to suppress grass growth. A mixture of 3.5 *kg of seed plus pod with* 126 *kg superphosphate/ha is suitable for planting. Discing will reduce the time needed to obtain a satisfactory stand.*

Application of superphosphate doubles the yield of legume and increases the phosphorus content of the material.

Heavy stocking rates may result in elimination of the perennial grasses from the pasture, and, with improvement in soil fertility, these may be replaced by annual grasses.

Maximum legume yield may be obtained with 63 *kg superphosphate per hectare but a level of* 125 *kg increases phosphorus content as well. A total of* 375 *kg. per hectare over* 3 *years should provide sufficient phosphorus to last for* 4-5 *years.*

Application of copper, zinc and molybdenum increases dry matter yield of the legume. Inclusion of these minerals in the first two fertilizer dressings should suffice.

Animal performance on both Townsville stylo and native pastures is seasonal. At similar stocking rates, steers grazing fertilized Townsville stylo pastures gain at a faster rate and for a longer time than those on native pasture. The performance on unfertilized Townsville stylo is intermediate.

While a stocking rate of 1 *beast/*2 *hectare is a safe rate for set stocking, wastage of legume through spoilage by winter rain, fogs and dews is high. An integrated approach of grazing the legume as a summer crop and utilizing native pastures with supplements in the dry is suggested.*

Feeding of a phosphorus supplement to steers grazing unfertilized Townsville stylo pastures during the wet season should improve liveweight gains.

An economic appraisal would suggest that the return to invested capital in a steer fattening enterprise on fertilized Townsville stylo should be of the order of 15-20%.

INTRODUCTION

One of our greatest assets in northern Australia is the vast area of native pasture which carries the majority of our beef cattle population and will continue to do for many years to come. However, these native pastures have some severe limitations, among which is a short growing season, resulting in early maturity and rapid deterioration. Nitrogen content of this material is low, especially after maturity is reached, and animal performance is correspondingly low. By increasing the nitrogen supply to the animal, overall performance should improve. There are two main methods by which this can be achieved on native pasture:—

(a) Feed a nitrogen-rich supplement
(b) Introduce a legume into the pasture.

The introduction of supplementary feeding with nitrogen has improved the nutrient status of animals and reduced the losses normally sustained. It is my intention to consider the alternative method of improving nutritional levels i.e. the introduction of a legume into the pasture.

The legume which has made itself "at home" in the 60-100 cm rainfall region is Townsville stylo, an annual legume which was introduced through Townsville late in the last century. This has been one of the very few cases where an accidental introduction has proved to be quite beneficial.

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Research into the role Townsville stylo might play in the beef industry of this area was commenced at "Swan's Lagoon" with the planting of an area of pasture in November-December 1964. The work is still continuing and a good deal of information is now available regarding the best way to use that type of pasture. These findings will be considered in this paper.

ESTABLISHMENT

Several methods of establishment have been employed at "Swan's Lagoon" over the past six years and all have proved successful. In initial plantings, the following procedure was followed. The dry native pasture was burned in October and the area was disced with off-set tandem discs. The seed was applied at a rate of 4.5 kg per hectare to the surface of the cultivated soil through a combine with the feet removed. Following the storms when the legume seed had germinated, the area was stocked so as to suppress grass growth and allow the legume to become established. When the legume flowered, the stock were removed to allow maximum seed set, and re-introduced in August.

On treatments where fertilizer was to be applied, the seed and fertilizer were mixed, but on unfertilized areas sand was mixed with the seed for planting. There was a suggestion that the fertilizer may have burned the seed as fewer plants established on the fertilized area. However, the reduction was not serious and mixing of seed and fertilizer for planting is considered satisfactory unless it is intended to store the mixture for any length of time. The above planting method gave a good stand of Townsville stylo in the first year and an excellent stand in the second year (50: 50, grass: legume).

More recent plantings have been carried out without disturbing the soil, with seed being applied directly on to burnt country. This method has proved successful but it has been 2-3 years before a good stand resulted. In December 1968, 3.5 kg seed and 125 kg superphosphate per hectare were applied from an aircraft. Despite the fact that the 1969 drought followed, a good stand of legume had developed by 1971. In the latest planting, straight seed was applied at 3.5 kg per hectare through a conventional "spinner-type" fertilizer-spreader and a reasonable distribution of plants has resulted.

The procedure currently recommended on these light sandy soils is as follows:—

October-November	— burn standing pasture
December	— plant (3.5 kg seed + 125 kg super) on surface; stock immediately
March	— remove stock to allow seeding
July-August	— restock.

When to remove stock will be dependent on the strain of Townsville stylo used i.e. the flowering time. It is important that the area is not burnt for at least two years after planting.

In Central Queensland, discing of strips through the standing native pasture and planting on these strips only has proved successful.

EFFECT OF FERTILIZERS

There are many arguments regarding the "pros and cons" of applying superphosphate to a Townsville stylo stand. Application of fertilizer will have an effect on:—

(a) Yield of pasture
(b) Legume-grass ratio
(c) Chemical composition of the material
(d) Animal performance.

This last point will be considered later in the discussion.

(a) *Yield*

In studies carried out over the past seven years, application of superphosphate fertilizer has had a dramatic effect on the growth of the pasture. During the earlier years, the fertilizer caused a doubling of the yield of the Townsville stylo and also increased the growth of the perennial native pasture. However, as time went on, there was a marked change in pasture composition and growth of legume, as a result of fertilizer application, which leads us on to the next point.

(b) *Legume-grass ratio*

As the initial discing had destroyed much of the perennial grass, the heavy stocking pressures used (1 beast per 1.2 hectare and 1 beast per 2.4 hectare) gradually killed out the perennial grass which remained. The normal stocking rate for the area is regarded as 1 beast/8 ha. It can be seen from Figure 1, that the perennial grass occupied only a very small percentage of the pasture by 1967, 3 years after planting. As soil fertility improved with time as a result of increased phosphorus, nitrogen and organic matter content of the soil as well as other minor elements, annual grasses began to invade the fertilized areas. By 1971, the pasture had changed from a 90% legume: 10% grass pasture to a 10% legume: 90% grass pasture. In 1972, there has been a suggestion that the growth of grass has commenced to decrease while the legume growth has increased slightly. It is possible that the grass is exhausting the soil fertility and that a cycle has commenced which will cause a swing back to legume dominance. However, it is too early to say this with any confidence. How serious this problem is is a matter of opinion. It would seem, from considering the animal performance figures that there has been no marked decline in animal performance as the percentage of annual grass in the pasture increased, but we require figures over a longer period. This problem of annual grass invasion must not be taken too lightly. It can be seen from Figure 1 that the annual grass has become a problem only on fertilized areas and that unfertilized areas remain virtually pure legume. Research at other centres, Katherine, Rodd's Bay, Lansdown, has encountered the same problem and it was shown that the amount of grass invasion which occurred was related to amount of annual grass seed present and the quantity of fertilizer applied. It is the combination of phosphorus and nitrogen which stimulates the grass growth. It would certainly seem unwise to fertilize hay-producing areas as invasion by annual grasses and weeds is almost inevitable.

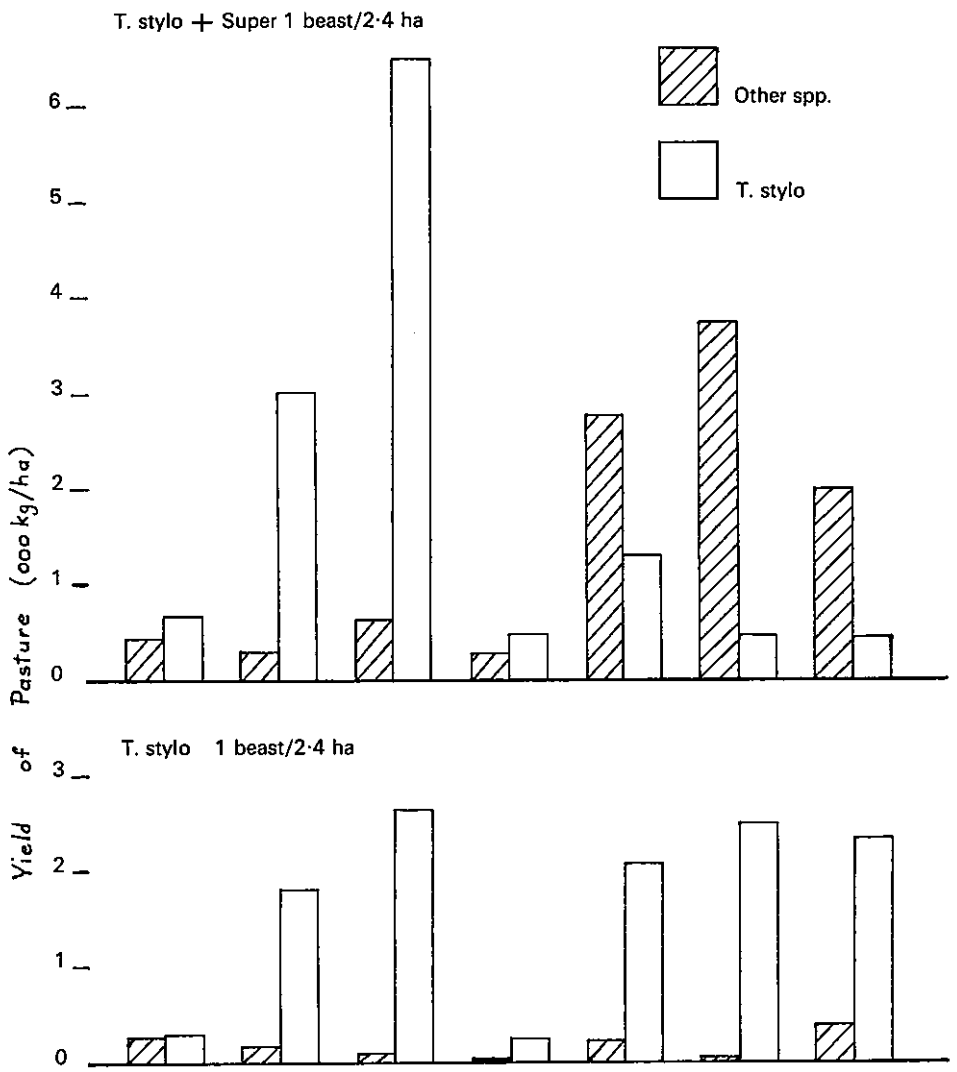
Several methods of avoiding this annual grass problem have been suggested:—

(i) Do not disc at establishment. On an area at "Swan's Lagoon" which was planted in 1967 and fertilized annually since at 125 kg per hectare, the ratio of legume to grass in 1972 was 15 : 85. The grass component is principally perennial grass and the stocking rate has been one beast per 2.4 hectares since 1967. However, at higher stocking rates the problem may have developed.

(ii) Less frequent fertilizing e.g. every second year, or lower maintenance dressings e.g. 63 kg per hectare per year.

(iii) Stock very heavily in the wet. This would aim at reducing seed set in the annual grass while it is a small percentage of the total pasture and reduce the rate of spread.

(iv) Introduce an improved perennial grass. This grass could be introduced at establishment or when the pasture became legume dominant, and would provide competition for the annual grass. This would have the added advantages of producing a greater bulk of feed, reducing the erosion hazard and producing rapid growth following winter-spring or early-summer rains. Possible grass species might be *Urochloa* spp. or *Cenchrus* spp. (Buffel grasses).



Annual Liveweight Increase (kg)

Super	120	112	166	52	222	130	110
Nil	49	29	102	*	186	89	70
Rainfall (cm)							
	37·2	73·9	131·7	33·5	76·5	106·8	104·1

* Removed in August

FIGURE 1
Pasture presentation yields on fertilized and unfertilized Townsville stylo stocked at 1 beast/2.4 ha over the period 1966-72 as related to animal performance and rainfall.

(c) *Chemical composition*

The major effect on chemical composition has been a lift in the phosphorus content of the feed. At 125 kg "super" per hectare, phosphorus content was raised from 0.10% to 0.20% phosphorus. As phosphorus is essential for the correct functioning of most bodily processes, this increase in phosphorus content has a marked effect on animal performance. In drier years, when dry matter yield of pasture was not high, nitrogen content of the legume was also higher on fertilized areas (2.60 *V* 2.10 per cent) but this did not occur in "normal" years. Sulphur content has also been raised by fertilizer application (0.20 *V* 0.16 per cent).

HOW MUCH FERTILIZER?

The questions that are most often asked in connection with Townsville stylo, I feel, are "How much fertilizer should be applied? When do I stop fertilizing?" On these soils, the maximum growth of the legume was obtained with 63 kg "super" per hectare but the quality of the material in terms of phosphorus and sulphur content is no better than that of unfertilized material. By increasing the rate to 125 kg per hectare the phosphorus content is virtually doubled. At progressively higher dressings the phosphorus content is steadily increased. On areas where 375 kg had been applied, dry matter yields were still at a maximum four years later and the phosphorus content was still at a satisfactory level. This would suggest that if 375 kg per hectare were applied to an area, further applications should not be necessary for 4-5 years. I would favour three successive dressings of 125 kg per hectare as opposed to a single dressing of 375 kg per hectare as three times the area can be treated at any one time.

Investigations on the role of trace elements have been carried out using molybdenum, copper, zinc, and sulphur. The picture which has emerged has been that a combination of molybdenum, copper and zinc has increased the yield, especially in dry years. As these elements are required in small quantities only, it is recommended that they be included in the fertilizer for two years and then omitted for 4-5 years.

Where nitrogen was applied to areas, there was a more rapid establishment and better early growth of the legume, but final dry matter yields were no better as a result of nitrogen application.

ANIMAL PERFORMANCE

The overall picture as regards animal performance is that beef production has been markedly improved on fertilized areas. The attached graph (Figure 2) which covers the period January 1967—May 1968 shows the typical pattern of animal performance on native pasture and fertilized and unfertilized Townsville stylo. In general, there has been a seasonal pattern of performance on all three pastures, with a period of weight gain followed by a period of weight loss. Even on fertilized areas animals have suffered weight losses during the dry season in all years. The major differences which exist between the different pastures in terms of animal performance are in the rate of gain and the period of gain.

Steers on the fertilized pasture gain at a faster rate and for a longer period of time than those on unfertilized Townsville stylo or on native pasture. This arises because there is a greater quantity of better quality feed on the fertilized area and animals are able to select a better quality ration for a longer period of time. Animals on the unfertilized pasture are generally intermediate between those on the other two pastures. They generally gain faster than those on native pasture and for a longer period as well. Once weight losses commence, they occur at a similar rate on all areas, except where the pasture is virtually pure legume in a dry year, when dry matter may be exhausted. In this situation, unfertilized pasture may "crash" and animals have to be removed in the dry. The average situation is that gains will

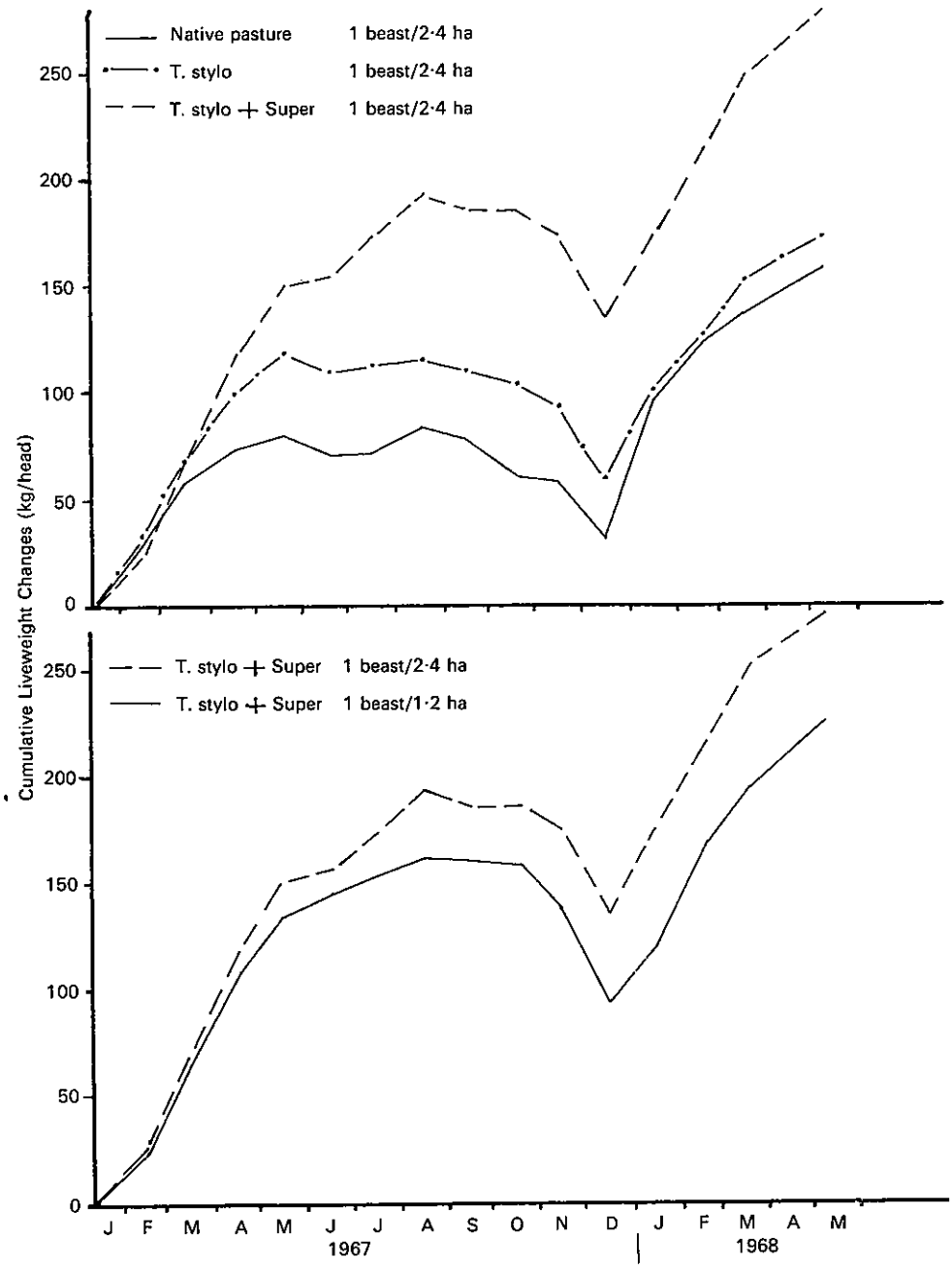


FIGURE 2
Animal performance on the three pasture types and on fertilized pasture at the two stocking rates in 1967-68.

continue until May-June on native pasture, June-July on unfertilized Townsville stylo and August-October on fertilized Townsville stylo, all at 1 beast/2.4 hectare.

Following the break in the season, there is a "time lag" for the Townsville stylo to become established and provide an adequate ration for stock. Consequently, if animals are grazing an area which is predominantly legume, gains in the first six weeks after the storms are lower than those on native pasture which grows rapidly during this period. This can be seen on the graph during the early part of the 1968 wet season where gains in the first month were: N.P. 66 kg; T.L. 40 kg; T.L. + S. 40 kg. For this reason it is better for animals to have access to grass pasture during the early wet.

CARRYING CAPACITY

The typical pattern of animal performance applies with a depression in performance as stocking rate increases (Figure 2). This depression is more pronounced in drier years when dry matter is limited. Until the legume flowers in April, stocking rate has little effect on weight gains, but, from April onwards,weight gains are lower at the higher stocking rate. In general, fertilized pasture will support gains until August-October at 1 beast per 2.4 hectare and June-July at 1 beast per 1.2 hectare. Thus, by increasing the stocking rate, the period of gain is reduced. In drier years, where Townsville stylo dominant pastures are used, weight losses may be quite severe in the dry season and deaths from starvation would be inevitable. The stocking rate of one beast per 2.4 hectare on fertilized pasture has been completely safe for steers and animals went through the 1969 dry season without assistance and without getting low in condition.

In all years, heavy mould development has occurred on the hayed-off Townsville stylo. The winter rain, fogs and dews provide an ideal climate for mould growth on the dry material. This development of mould combined with the leaching effect of the moisture lowers the quality of the feed and digestibility drops. The animals eat less and utilize less of what they eat so this has a "double-barrelled" effect. Winter-spring rain is therefore detrimental to Townsville stylo but beneficial to native pasture or improved grasses in that it produces a green shoot.

In view of these facts, it is suggested that an integrated approach to the utilization of Townsville stylo and grass pastures should be adopted. The ideal approach would seem to be:— Stock would graze native pastures for the first 6-8 weeks after the storms, then would graze the Townsville stylo pasture at heavy stocking rates, which may be as heavy as 1 beast per 0.4 hectare in good years, until about May. At this time, they are given access to both the legume pasture and native pasture with a nitrogen supplement for the dry season. A suggested ratio would be to have 0.4 hectare of Townsville stylo and 1.6-2.0 hectare of native pasture per beast. Gains on the Townsville stylo would be lower than at lighter stocking rates but it is felt that overall utilization would be better. This system would of necessity have to be flexible to make allowance for dry years when growth of Townsville stylo is poor.

It is argued whether pure legume or legume-grass mixtures are best. There are arguments for and against both systems, the main problem being in maintaining a stable pasture. I feel that areas of pure legume in association with native pasture are preferable, but unfortunately we do not know how to maintain this situation at present.

PHOSPHORUS SUPPLEMENTS

It has been evident throughout these studies that animals on unfertilized areas have gained less than those on fertilized areas. Faecal phosphorus and blood phosphorus analyses revealed that the phosphorus intake of animals on unfertilized areas was lower than on the fertilized areas. A supplement of black phosphoric acid (5 gm P/head/day) in the drinking water has produced no response on fertilized

areas but has improved weight gains on unfertilized areas during the period of positive weight gain, December-June (20 kg increase in 1970-71 and 34 kg to date in 1971–72). On this marginally deficient country, there is an advantage to be gained in feeding a phosphorus supplement during the wet season to steers grazing unfertilized Townsville stylo.

ECONOMICS

Opinions vary on the economics of applying superphosphate to Townsville stylo in this area. In an economic appraisal of the results obtained over the first four years of this trial, Mr. I. Robinson, Economist with the Department of Primary Industries, determined that returns to additional invested capital in a steer-fattening operation were of the order of 15-20 per cent. He concluded that investment in both Townsville stylo and fertilizer was economically sound.

NEW LEGUMES

It is obvious that Townsville stylo has many shortcomings in this area, the principal ones being the absence of growth in the dry season, poor growth in below-average rainfall years, and susceptibility to mould growth during the winter-spring period. A good deal of research is being carried out by C.S.I.R.O. at Lansdown to attempt to develop other perennial legumes which will overcome these shortcomings. This work is quite promising and it may not be long before better legumes than Townsville stylo are selected for this area.

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