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# Productivity response of signal grass (*Brachiaria decumbens*) to N fertilization

[Gerak balas daya pengeluaran rumput signal (*Brachiaria decumbens*) terhadap pembajaan N]

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Key words: forage quality, N fertilizer, N utilization efficiency, productivity, signal grass, soil fertility

**Abstrak**

Kesan beberapa kadar baja nitrogen (N) terhadap pengeluaran bahan kering, kecekapan penggunaan N, mutu foraj rumput signal (*Brachiaria decumbens*) dan status kesuburan tanah telah dikaji. Lima kadar baja N iaitu 0, 200, 400, 600 dan 800 kg N/ha setahun telah digunakan. Corak blok rawak lengkap dengan lima pereplikatan telah digunakan.

Rumput signal bertindak balas secara berkesan terhadap pemberian baja N dengan hasil yang tertinggi sebanyak 17 570 kg bahan kering sehektar setahun pada kadar baja 800 kg N/ha setahun. Kecekapan penggunaan N pula mencapai tahap yang maksimum pada kadar baja N sebanyak 400 kg N/ha setahun dan seterusnya berkurang dengan penambahan kadar baja N.

Kepekatan N di dalam rumput signal telah bertambah dengan meningkatnya kadar baja N. Sebaliknya, kepekatan K berkurang manakala P, Ca and Mg tidak begitu dipengaruhi oleh pembajaan N.

Keadaan pH tanah dan kandungan jumlah N, P, K, Ca dan Mg di dalam tanah tidak dipengaruhi oleh kadar baja.

**Abstract**

The effects of various rates of nitrogen (N) fertilizer on dry matter production, N utilization efficiency, forage quality of signal grass (*Brachiaria decumbens*) and soil fertility status were studied. Five rates of N fertilizer namely 0, 200, 400, 600 dan 800 kg N/ha per year were used. Randomised complete block design with five replications was used.

Signal grass responded markedly to N fertilizer application, with the highest yield of 17 570 kg/ha dry matter per year at 800 kg N/ha per year. The N utilization efficiency achieved maximum level at a fertilizer application of 400 kg N/ha per year and it decreased thereafter with the increase in N application.

The N concentration of signal grass increased with increasing rates of N fertilizer application. On the other hand, K concentration decreased while P, Ca and Mg were not much affected by N fertilization.

The soil pH and the total N, P, K, Ca and Mg content in the soil were not affected by the treatment levels.

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## Introduction

In Malaysia, applications of N fertilizer are normally required to produce high yields of grasses (Keeping 1951; Ure and Mohamad 1957; Tham 1980). The response to N fertilizer needs to be investigated since different grass species respond differently to N fertilizer application. In addition, N fertilizer also influences the chemical composition of the plants as well as the soil fertility status.

Signal grass (*Brachiaria decumbens*) is a pasture grass with good agronomic potential. Being a high-yielding and stoloniferous grass, it is adapted to a wide range of well-drained soil in humid tropical areas (Graham 1951; Loch 1977; Wong et al. 1982). Chen et al. (1982) had found that this grass, when fertilised with 300 kg N/ha per year gave an optimum stocking rate of 7 heads/ha with good liveweight gain of 1 018 kg/ha per year. However, information on its fertilizer response is limited. Therefore, a study on signal grass was conducted to investigate its yield response to N fertilizer, its N utilization efficiency and the effects of N fertilizer on forage quality and soil fertility status.

## Materials and methods

The experiment was conducted on a well-drained Serdang sandy loam soil (Typic Paleudult). The treatments consisted of five rates of N fertilizer mainly 0, 200, 400, 600 and 800 kg N/ ha per year with urea as the N source. The fertilizer was applied after every harvest at 6-weekly intervals. The experiment was laid out in a randomised complete block design with five replications.

Prior to planting, basal P and K fertilizers were applied to all plots and N fertilizer to all plots except the control plots. Triple superphosphate (TSP) and Christmas Island rock phosphate (CIRP) as phosphate fertilizer were applied at 30 kg P/ha each. Muriate of potash (MP) at 50 kg K/ha and urea at 60 kg N/ha were also applied. Maintenance fertilizers at 150 kg P/ha per year (TSP) and 200 kg K/ha per year (MP) were applied three times a year. Weeding was done manually, when necessary.

Signal grass was planted using stem cuttings spaced at 30 cm x 50 cm apart in a plot of 4 m x 5 m. It was cut at 6-weekly interval at 10 cm above the ground level. The harvested portions were weighed, subsampled and oven-dried at 70 °C for dry matter yield determination. The dried samples were ground for chemical analysis. The N, P and K concentrations in the plant samples were analysed using an autoanalyser while concentrations of Ca and Mg were determined by an atomic absorption spectrophotometer. Soil samples at a depth of 0–15 cm from the ground level were taken every 6 months for a period of 2 years. The samples taken were placed in plastic bags, air-dried, ground and sieved (1-mm gauge) and kept for chemical analysis. Soil pH was determined using a pH meter (1:2.5, soil to water) while total N was analysed using a micro-Kjeldhal method. Available P was determined by an autoanalyser while exchangeble K, Ca and Mg using atomic absorption spectrophotometer. The N utilization efficiency of the grass was estimated in terms of kilograms of dry matter produced per kilogram of N applied.

The data were analysed using analysis of variance (ANOVA) table and further subjected to Duncan's Multiple Range Test Correlation, and regression analyses of the data were also done.

## Results and discussion

Changes in the dry matter yields of signal grass are illustrated in *Figure 1*. The rainfall did not influence the dry matter yield for the period of the study. However, there was a large drop in the dry matter yield of the grass in all the treatments at the February/ March 1987 harvest. Environmental factors such as sunshine hours, air and soil temperature which were not recorded may have affected the plant growth (Ng 1972).

The annual dry matter yield significantly increased ($p < 0.05$) with

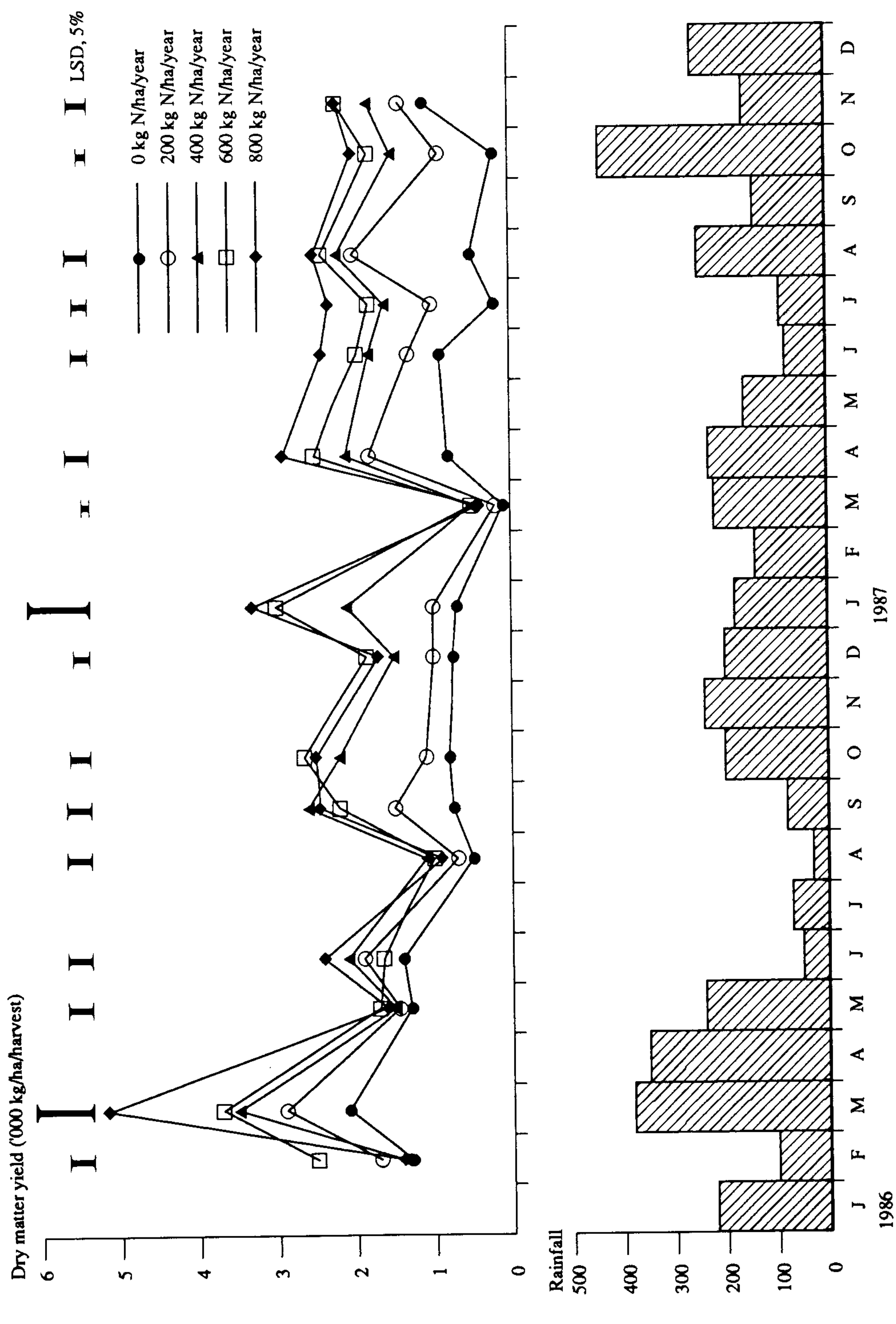


*Figure 1. Seasonal dry matter yield of signal grass after 6 weeks of regrowth over 21 months in relation to monthly rainfall during the 2-year period*

increasing rates of N application (*Figure 2*) following the quadratic equation curve $y = 7\,290.01 + 25.65x - 0.016x^2$ ($R^2 = 0.94$)

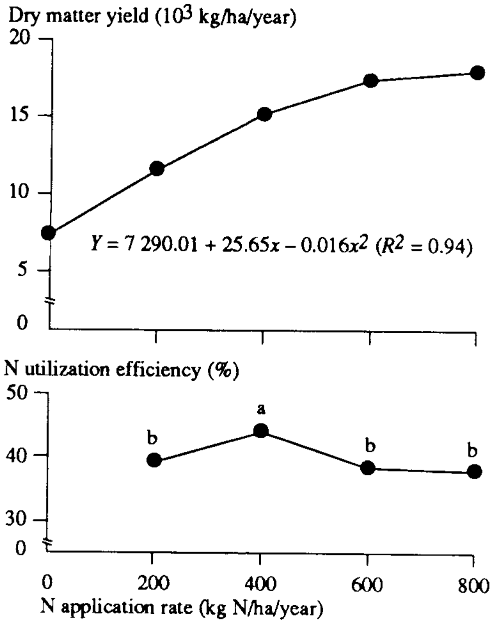


*Figure 2. Effect of N application rates on annual dry matter yield and N utilization efficiency of signal grass over 2 years*

which started to plateau at the estimated rate (level) of 802 kg N/ha per year and producing a dry matter yield of 17 570 kg/ha per year.

The dry matter yield of signal grass obtained in this study was lower than that obtained by Ng (1972) and Wong et al. (1982) who reported dry matter forage production of 19.0 t/ha with 224 kg N/ha per year and 24.0 t with 300 kg N/ha per year respectively. Variation in yields can occur within wide limits depending on the weather conditions of the year, water supply, soil fertility, the amount of fertilizer applied and management practices (Crowder and Chheda 1982).

In this experiment, the N utilization efficiency for signal grass increased significantly ($p < 0.05$) from an application of 200 to 400 kg N/ha per year but decreased with further increase in N application (*Figure 2*). Ng (1972) showed that the maximum recovery of about 50% occurred at 224 kg N/ha per year beyond which there was a decrease in efficiency. Tham (1980) reported a decrease in the N

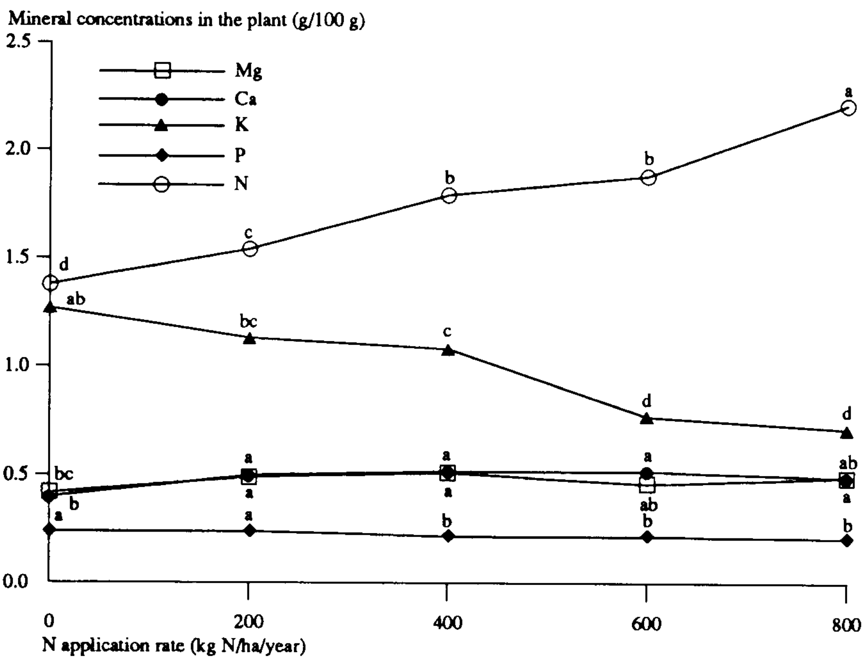


*Figure 3. Effect of N application rates on mineral concentrations and N in the plant*

utilization efficiency from 42% to 30% with increasing rates of N fertilizer applications of 200–400 to 800–1 600 kg N/ha per year. The fall in N recovery with increasing N rates has been due to the reduction in N uptake, as the plant's capacity to assimilate N approaches saturation (Tham 1980).

The N concentration in the grass increased significantly ($p < 0.05$) with increasing rates of N fertilizer (from 0 to 800 kg N/ha per year). However, the increase was at a slow rate as shown in *Figure 3*. The K concentration of the grass decreased significantly ($p < 0.05$) with increasing N fertilizer application (*Figure 3*). Factors such as seasonal conditions, stage of plant growth, plant part and the supply of other nutrients e.g. N supply in this experiment may affect the K levels in the grass. The P, K, Ca and Mg concentrations were, however, unaffected by the levels of N application (*Figure 3*). Results of this experiment suggest that the application of 400–600 kg N/ha per year to signal grass was sufficient to maintain forage quality above the recommended dietary content of N and mineral concentration for finishing cattle weighing 300–500 kg body weight (Minson et al. 1976).

The soil pH decreased significantly ($p < 0.05$) from 4.0 (0 kg N/ha per year) to 3.6 (800 kg N/ha per year) (*Figure 4*). This could be due to acidification that occurs during mineralisation and leaching of $NO^{-3}$ which removes cations. Application of urea at 400 kg N/ha per year over a 2-year period caused the soil pH to decrease by about one unit (Crowder et al. 1963). In another study, the soil pH of Serdang series dropped from 4.20 to 3.83 and 4.17 in guinea and napier plots, respectively with continuous application of inorganic fertilizer at 400 N:80 P:160 K using urea, TSP and MP fertilizer sources, respectively for 3 years (Mohd Najib and Hassan 1985).

Available P was also reduced with the increase in N fertilizer application. Soil total N and exchangeable K, Ca and Mg were generally unaffected by the N fertilizer application (*Figure 4*).

## Conclusion

Results obtained from this study show that high dry matter yields of signal grass can be achieved with N fertilizer application up to 800 kg N/ha per year. High rates of N fertilizer application, however, need to be considered in relation to the chemical composition of the plant, the soil fertility status and the N utilization efficiency in order to obtain the economic use of the N fertilizer. The maximum N utilization efficiency for signal grass obtained in this study was at an application of 400 kg N/ha per year.

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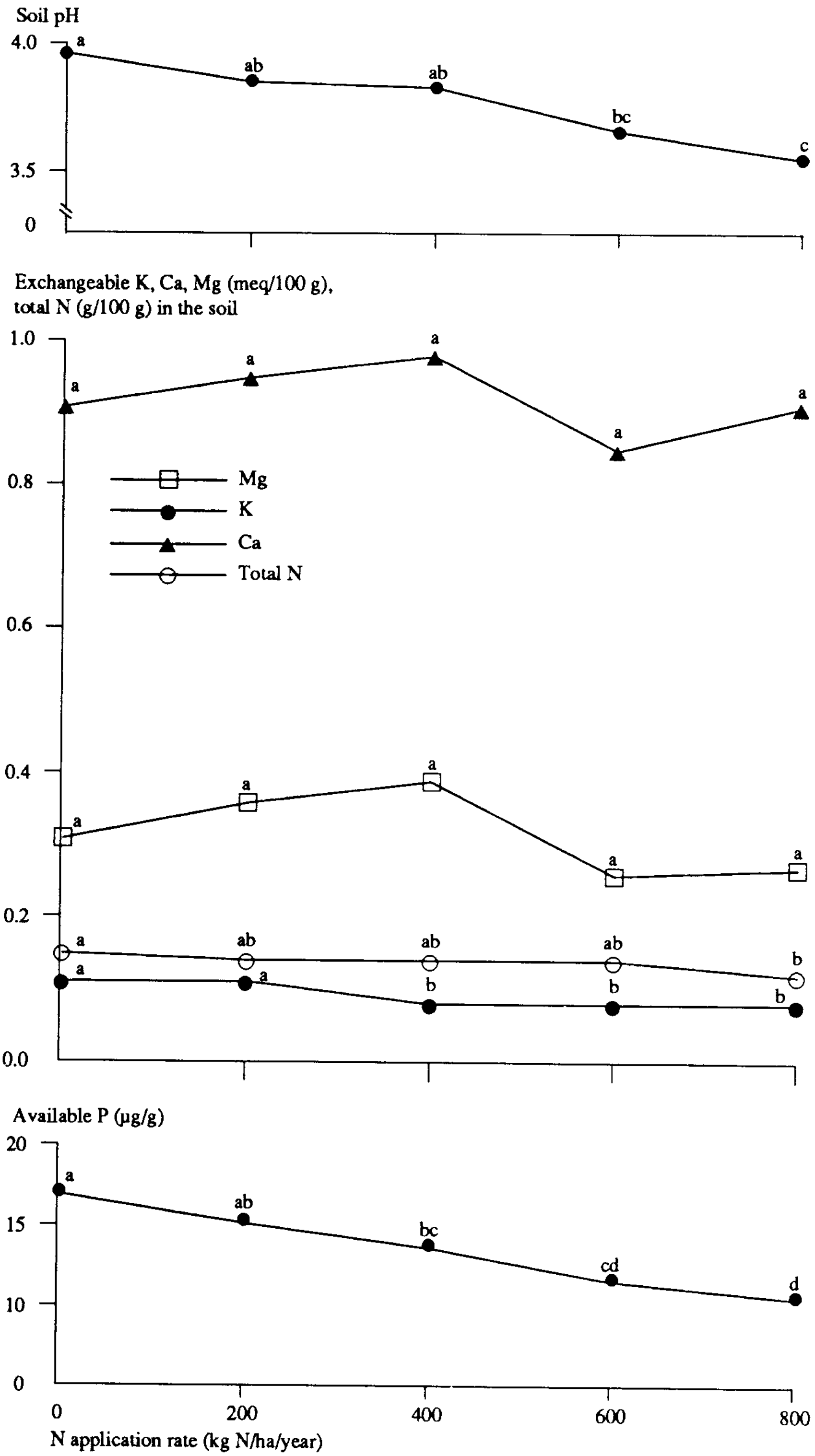


*Figure 4. Effect of N application rates on the soil properties*

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