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Yield and yield prediction of guinea grass pastures

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Native pastures are the most important source of feed for the livestock industry in St. Croix, U.S.V.I. One of the major constituents of these pastures is guinea grass (*Panicum maximum*), found in well managed, properly stocked situations. To determine the dry matter production of this species, plots were established in existing swards located in different rainfall zones. The plots were cut periodically for a full year. Yields at each site varied according to rainfall: from 7,543 kg/ha in the driest location to 14,445 kg/ha in the wettest area. Before the plots were cut, the height of the grass was measured. Regression analysis was performed, and a strong relationship between height and dry matter yield was demonstrated. This failed to adequately predict hay yields due to uneven cutting heights and inefficient raking with large equipment. Care must be taken when using regression techniques to predict dry matter production.

Keywords: Guinea grass; Panicum maximum; Yields; Yield prediction

Introduction

Natural guinea grass (*Panicum maximum*) pastures in St Croix are green chopped, grazed or made into hay, and are one of the most important feed sources for livestock production in the island. Prohibitively high costs preclude routine application of fertilizers, and the pastures are generally managed under natural fertility conditions.

Despite the importance of this grass, however, relatively little is known about its growth and production. Applying no fertilizer, Oakes (1966) found that the five year average of guinea grass yields increased from approximately 11 tons per ha with a 2 month harvest interval to 14.5 tons per ha with a 6 month interval. The trial, though, was conducted at only one site, and since rainfall varies greatly in St Croix, results are difficult to extrapolate to other parts of the island. Knowledge of the production of guinea grass would be helpful in establishing stocking rates and useful in determining yields from green chopping and hay making operations. Farmers could then determine the number of animals they can safely support without damaging their swards. Pasture management would be facilitated, and long-term planning could be implemented.

While the knowledge of guinea grass yields are valuable, a method of determining the amount of standing forage prior to utilization would be useful, also. Harvesting for hay or green chop could then be performed when a desired yield level is achieved. In addition, stocking rates could be adjusted to match the amount of forage in a pasture.

A number of simple techniques for determining standing forage are available. Perhaps the simplest, especially for the farmer, is to measure the height above ground level of the sward. This height can then be related to dry matter yields through a prediction equation calculated by means of regression analysis.

A trial was conducted to measure the production of guinea grass pastures located at different sites in St Croix. Concomitantly, the relationship between height and dry matter yields was determined, and the feasibility of using height as a predictor for hay yields was studied.

Materials and methods

The study utilized long-established guinea grass swards located at four sites of varying rainfall. After an initial staging cut made in February, 1986, three harvest frequencies (6, 12 and 24 weeks) were imposed on the guinea grass. These three treatments were replicated twice at each site.

Individual plots measured 3.0 x 12.2 m. A strip 1.0 x 10.0 m in the centre of each was cut with a self-propelled sickle bar mower to a stubble height of 7.6 cm. The plant material was collected and weighed fresh, and a sub-sample taken for dry matter determination. Data were collected over 48 weeks, at the end of which the 6, 12 and 24 week harvest frequencies had been cut a total of 8, 4 and 2 times, respectively.

After the cutting in each plot, the height of the grass on both sides of the harvest strip was measured with a metre stick. The mean height of the highest leaves in the immediate vicinity of the stick was recorded. A total of ten measurements was made, five on each side of the strip. The ten height measurements taken in each plot were averaged together, and the relationship between height and dry matter yields in all plots across all sites determined by means of regression analysis.

Sward heights were measured at four sites in a guinea grass pasture prior to cutting for hay. The heights from each site were averaged and used to calculate hay yields by means of the prediction equations that resulted from regression analysis. After the grass was cut and baled, the bales were weighed, sub-samples taken for dry matter determination, and actual yields compared to predicted ones.

Results

Rainfall strongly affected the amount of dry matter produced by guinea grass swards. When averaged over the three cutting intervals, yields at the two lowest rainfall sites were approxi-mately 7,500 and 9,000 kg/ha, respectively (Figure 1), for the 48 week duration of the trial. Yields at the sites receiving the highest rainfall were 12,000 and 14,000 kg/ha, respectively.

In general, the longer the interval between cuts, the greater was the production of dry matter (Figure 1) In two instances (900-1020 mm and 1140 - 1260 mm rainfall sites), yields almost doubled as the cutting interval increased from 6 to 24 weeks. The only exception to this trend occurred at the 1020 - 1140 mm rainfall site, where cutting every 24 weeks resulted in less dry matter than did cutting every 12 weeks. Regression analysis performed on the data combined from the 6 and 12 week cutting intervals showed a strong linear relationship between height and yields ($p \leq 0.01$, Figure 2). There was also a strong linear relationship ($p \leq 0.01$) between height and yield for the combined data of the 6, 12 and 24 week cuts. The prediction equations resulting from the two analyses, however, were slightly different, resulting in different predictions of dry matter yields, especially at higher sward heights (Table 1).

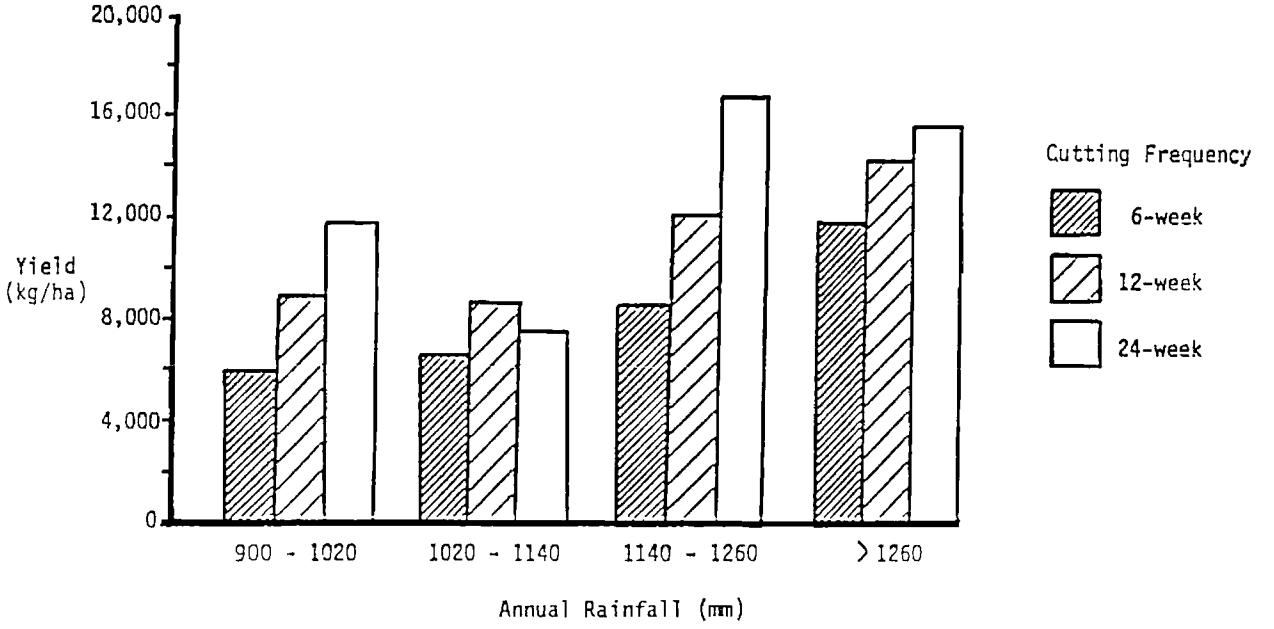

Fig. 1. The effect of annual rainfall and cutting frequencies on the dry matter production of guinea grass swards, St. Croix.

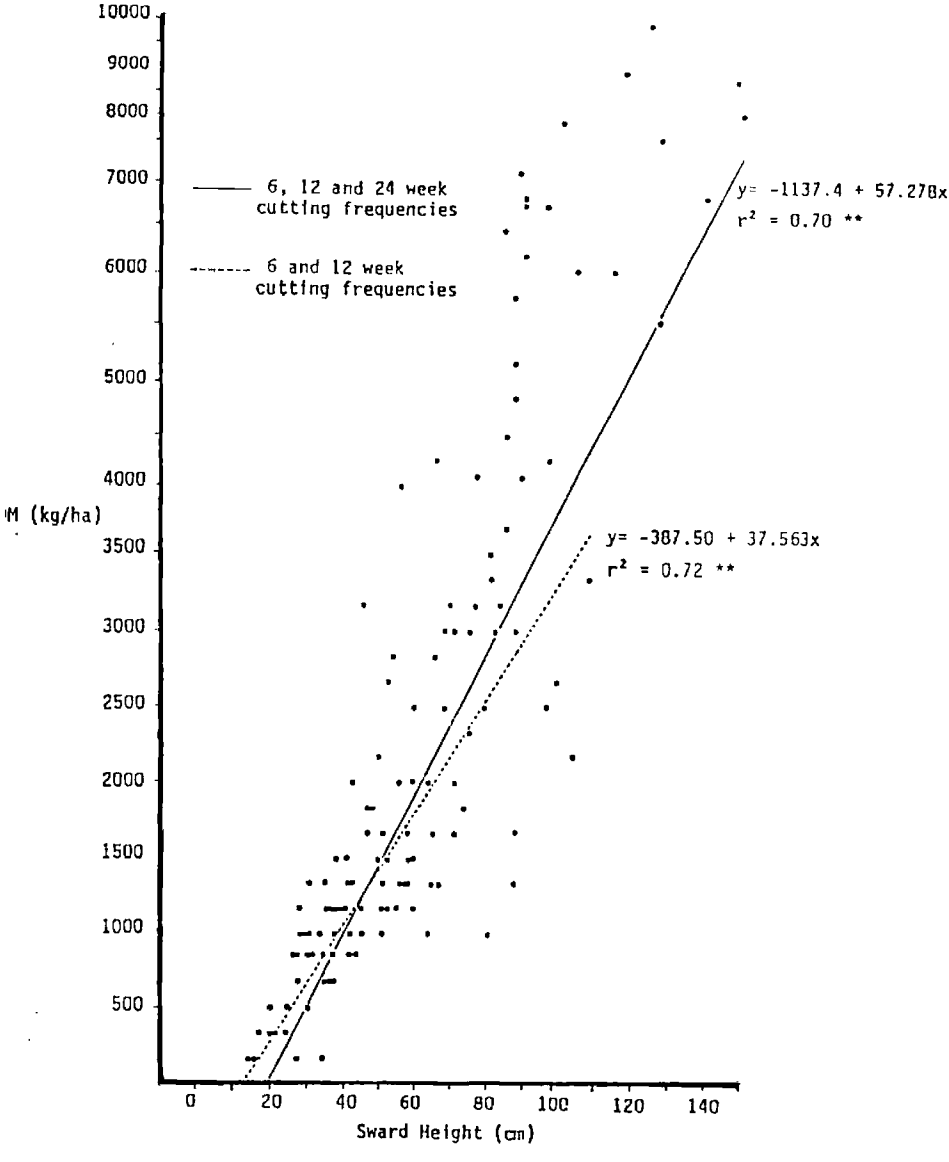

Fig. 2. Relationship between height and yield in guinea grass pastures

Table 1 Comparison of two regression formula for predicting dry matter yields from heights of guinea grass swards

Sward Height (cm)	Regression formula[1)] Formula 1 (6 & 12 week)	Formula 2 (6, 12 & 24 week)
	Predicted Yield -------- kg/ha --------	
25	550	290
50	1490	1730
75	2430	3160
100	3370	4590

1) Formula 1 has $y = 387.5+37.5x$; Formula 2 has $y = -1137.44 + 57.27x$ where y = DM yield (kg/ha) and x = sward height (cm)

Table 2 Comparison of yields predicted from sward height with actual yields from a grass pasture cut for hay

Site within pasture	Sward Height (cm)	Predicted Yield (kg/ha)	Measured Yield (kg/ha)
1	71	2265	960
2	67	2140	540
3	74	2410	710
4	79	2590	1170

Average sward heights within each of the four sites located in the guinea grass pasture cut for hay are shown in Table 2. Since the regrowth in this particular pasture was less than 12 weeks old, the formula generated from the analysis of the combined 6 and 12 week data was used to predict dry matter yields. Comparisons between actual and predicted yields showed that the prediction was poor and over-estimated the amount of hay that was actually baled. At least two factors may be responsible for this.

Yield data used in regression analyses were taken from plots cut at 7.6 cm height and carefully raked to collect all herbage. In the pasture cut for hay, however, cutting height varied from 10 - 15cm and some grass remained because of inefficient raking. In addition, the hay was cut so that the tractor tires packed the sward before the cutter passed over it, leaving strips of un-harvested grass.

There may be an inherent difficulty in the use of these regression formulae. During the course of the study, for example, actual yields at sward heights of 65 cm ranged from 1,700 kg per ha to 4,340 kg per ha, while predicted yields - using the regression formula for the 6 and 12 week data - were 2,054 kg per ha. Differences such as these could account for the discrepancies between the predicted and actual yields of the guinea grass pasture, and necessitate care in the use of formulae generated from regression analysis.

Reference

Oakes, A.J. (1966) Effect of nitrogen fertilization and harvest frequency on yield and composition of *Panicum maximum* Jacq. in tropics. *Agron. J.* 58 75-77