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ESTIMATION OF FORAGE MASS OF OLD WORLD BLUESTEM USING A VISUAL OBSTRUCTION MEASUREMENT TECHNIQUE

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Authors:

C.J. Ackerman, H.T. Purvis II, G.W. Horn, M.E. Payton, L.T. Vermeire, S.I. Paisley and T.N. Bodine

Story in Brief

A visual obstruction technique and hand clipped quadrats were used to develop prediction equations for estimating forage mass (lb DM/acre) of Plains Old World bluestem during the summers of 1997 and 1998. The technique used was a modification of a procedure developed in Kansas during the 1970s. This technique estimates visual obstruction using a pole which is marked incrementally along its length. When the pole is placed vertically in a sward and observed from a distance of 4 m, visual obstruction, or the amount of the pole which is obscured from view by standing forage, can be estimated. In order to estimate forage mass of Old World bluestem, 120 visual obstruction measurements were recorded (60 each year) and one .1 m^2 quadrat was clipped at the same point where each visual observation was recorded. Linear regression analysis was used to investigate the relationship between visual obstruction measurements and clipped forage weights and to develop equations for the prediction of forage mass using visual obstruction measurements. The r^2 values for regression of visual obstruction on clipped forage weights were greater than .50 for both years. The slopes of the regression lines for the two years were not different, indicating a similar relationship between visual obstruction measurement and clipped forage weights during both years. This technique has potential for practical use; additional data collected over several years may strengthen or increase the accuracy of the prediction equations.

Key Words: Old World Bluestem, Forage Mass Estimation, Visual Obstruction

Introduction

Estimation of forage mass is an important factor in grazing management. Clipping and weighing forage is the most accurate method for determining forage mass, but the time and labor required to conduct this method may limit its use, especially for producers (Harmoney et al., 1997). Robel et al. (1970) developed a method for measuring forage mass using a marked pole which may require significantly less time and labor than hand clipping techniques. These workers reported an equation that describes the relationship between visual obstruction measurements and the weight of vegetation clipped from quadrats. They observed an r^2 value of .95 between clipped vegetation and visual obstruction measurements for Kansas native grasses. Michalk and Herbert (1977) observed an r^2 value (visual obstruction vs clipped vegetation) of .80 for growing Lucerne pasture using a technique similar to the procedure developed by Robel et al (1970). Harmoney et al. (1997) reported an r^2 value of .63 for a combined regression of several different types of forage using visual obstruction measurements. These reports established a potential for using this technique to develop prediction equations for the estimation of forage mass.

The objective of this study was to evaluate the relationship between visual obstruction measurements and clipped forage mass for Plains Old World bluestem, and develop equations for prediction of forage mass using the pole developed by Robel et al. (1970).

Materials and Methods

Study Site. The study site was the Bluestem Research Range located seven miles southwest of Stillwater, OK. The forage type which was used for this trial consisted of Plains Old World bluestem (*Bothriochloa ischaemum* L. Keng). Visual obstruction samples were collected during August of 1997 and 1998 from 12 pastures. These 12 pastures were assigned to a stocking rate trial from May through August during both years. Stocking rates during 1997 were 350, 460, and 750 lb/steer live weight per acre and stocking rates during 1998 were 350, 550, and 750 lb/steer live weight per acre. Precipitation during 1997 was greater than the historical average, while precipitation during 1998 was less than the historical average (Figure 1).

Description of Robel Pole. The pole developed by Robel et al. (1970) was described as a round pole (3 cm diameter x 150 cm height) which was marked with brown and white paint at alternating decimeters. The mid-point of each decimeter was marked with a narrow black stripe which made it possible to distinguish half-decimeters. These workers determined that the most accurate ($r^2 = .9550$) readings of visual obstruction were made at 1 m of height and 4 meters away from the pole. Therefore, in order to establish exact distances for observation, 4 m of string are attached to the top of the large pole and the top of a second, smaller pole at 1 m of height. Using this smaller pole, one can extend the string to its full distance (4 m) and sight on the larger pole, which is placed vertically in the sward from a height of 1 m. The pole we used was modified by separating the lower 5 decimeters into quarter decimeters (2.5 cm) with black tape marks. Additionally, we used alternating red and white paint rather than brown and white.

Data Collection: During August of 1997 and 1998, 60 visual obstruction measurements (VOM) and clipped samples were collected from 12 separate pastures (five samples/pasture) each year. At each sampling site, a VOM was recorded and a .1 m^2 quadrat clipped to approximately 1 in above the soil surface. Clipped samples were taken at the same point or area as the VOM by placing the back side of the clipping frame against the base of the Robel pole and extending the long portion of the clipping frame in the same direction that the VOM was recorded. Clipped samples were dried at 55^{o}C for approximately 72 h and weighed.

Calculations. All clipped forage weights were converted from g/m^2 to lb/acre. Pasture was the experimental unit in this study, therefore, individual observations were pooled within pasture. Pasture means were then used for development of regression equations.

Statistical Analysis. Regression and indicator (dummy regression) analyses were conducted using PROC REG of SAS (1992) to determine the relationship between clipped weights and VOM and to examine the relationship between the slopes and intercepts of the regression lines for each year.

Results and Discussion

The results of the regression analysis indicated ($P<.05$) a linear relationship (Figures 2 and 3) between VOM and pounds of forage DM/acre for both years. This linear relationship suggests that for each centimeter increase in VOM, there was a consistent increase in forage mass. However, the equations derived from the two years had ($P=.03$) different intercepts, resulting in a different prediction equation for each year. The difference in the intercepts of the prediction equations between the two years may likely be related to the large difference in precipitation between the summers of 1997 and 1998 (Figure 1). Due to lower levels of precipitation in 1998, there may have been more forage DM per acre during this year. The forage may have been more mature and(or) had a higher DM content, resulting in increased DM per acre. The r^2 was .60 for 1997 and .57 for 1998, which may indicate a slightly greater accuracy for the 1997 prediction equation. The $S_{y \bullet x}$ values were 1607.1 for 1997 and 1561.6 for 1998 which may indicate a similar variability of samples collected during the two years. This variability does appear to be somewhat large, and more samples collected within each experimental unit should help to decrease this variability and increase the accuracy of the equation. The differences in the prediction equations between years may indicate a need for further collection of data. Collecting visual obstruction measurements and clipped weights for regression analysis over a series of years with wide differences in precipitation and other climatic conditions should strengthen the resulting equations and render the predictions more accurate.

Despite the fact that intercepts for the two years were different, the slopes of the regression lines were (P=.90) similar, which indicates a similar relationship between VOM and clipped forage mass for each year. This similarity of slopes between the two years may be a further support the validity of this technique. Furthermore, the r^2 values of .60 for 1997 and .57 for 1998 are similar to the values reported by Harmoney et al. (1997). These workers compared clipped weights of pure or mixed stands of alfalfa, big bluestem, birdsfoot trefoil, Kentucky bluegrass, red clover, smooth bromegrass, switchgrass, and tall fescue to VOM measurements and observed a r^2 of .63 for all forage types combined. The r^2 for VOM observed by Harmoney et al. (1997) was greater than the r^2 observed for other forage mass estimation techniques including a rising plate meter and a canopy height stick.

Stage of growth may be an important consideration in developing regression equations. Although samples were not collected in different seasons, it is possible that a separate equation may be needed for summer vs winter stages of growth. Further research should improve the accuracy of these equations. Additionally, there is a need to validate these equations with separate clipped weights collected in concurrence with the VOM and clipped weights used to develop the equations. However, the data collected from the summers of 1997 and 1998 indicate that there is potential for using visual obstruction measurement for estimation of forage mass of Plains Old World bluestem. This potential should merit further research of this technique. It is important to emphasize that this technique, and others like it, should be validated over a number of years under a variety of climatic and grazing situations in order to ensure accuracy of prediction.

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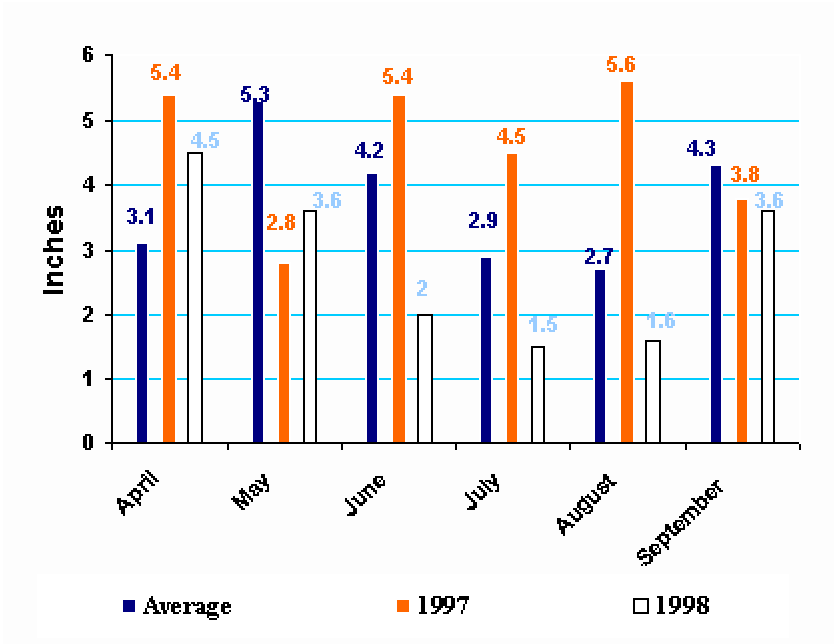

Figure 1. **Precipitation for April, May, June, July, August, and September of 1997 and 1998 for the Marena site of the Oklahoma Mesonet system near the bluestem research range and the historical average for Payne County, OK.**

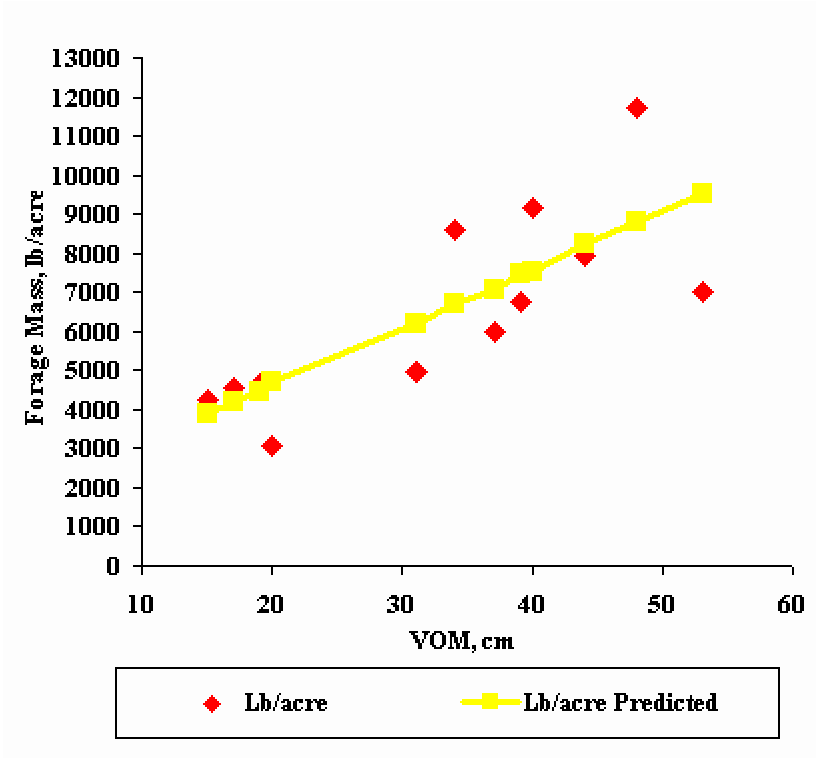

Figure 2. **Relationship between pounds of forage DM/acre and visual obstruction measurement (cm) for Plains Qld World bluestem in August of 1997.**

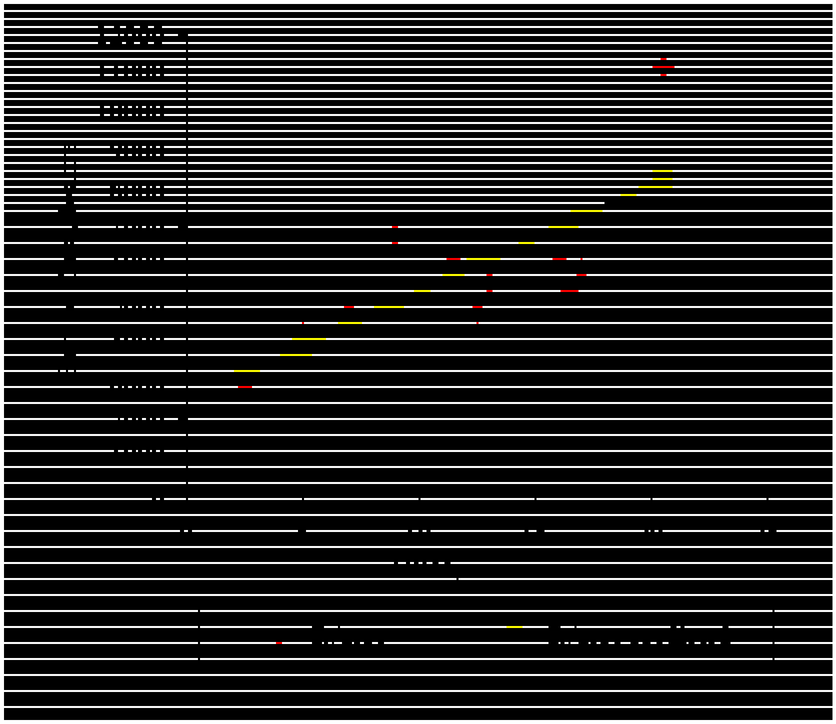

Figure 3. Relationship between pounds of forage DM/acre and visual obstruction measurement (cm) for Plains Old World bluestem in August of 1998.

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