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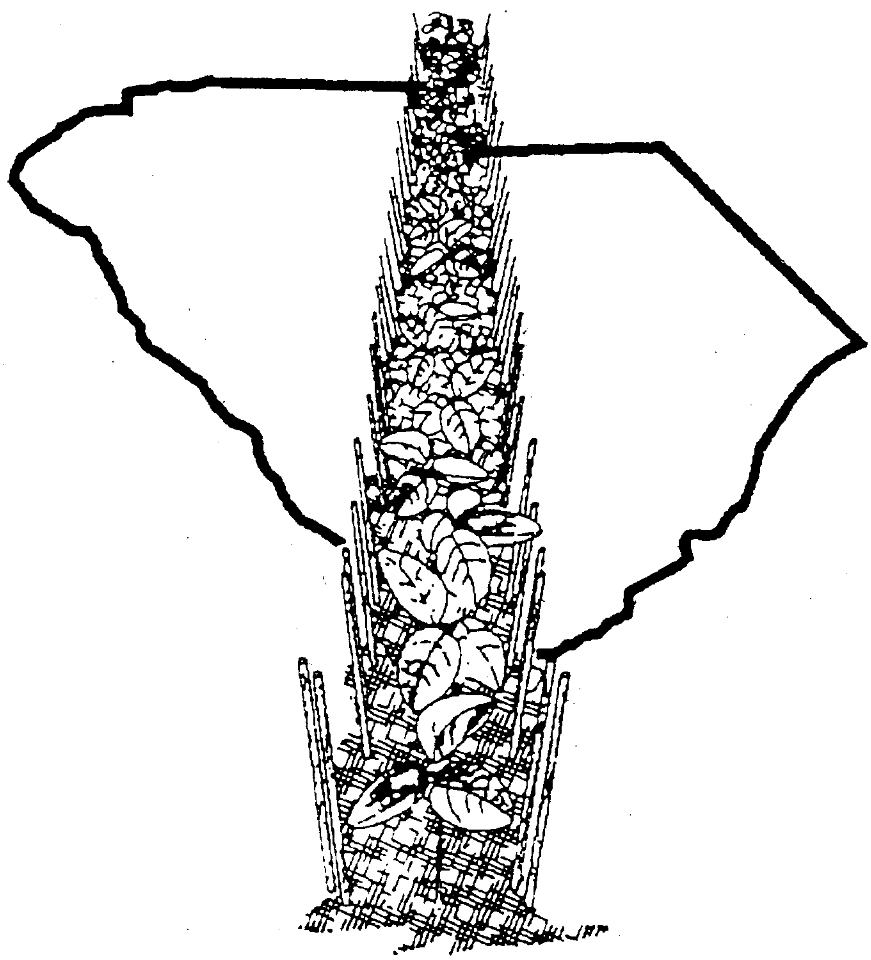

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ADJUSTING GRAIN YIELD OF BIRD DAMAGED PEARL MILLET

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ABSTRACT

Pearl Millet [Pennisetum glaucum (L.)R. Br.] is a potentially-productive, high-quality grain crop that is highly susceptible to bird damage in small plots and in areas around the outside of large fields. Treatments that change the physiological maturity (specifically the soft dough stage which red winged blackbirds [Agelaius phoenicens] seem to prefer and seek out) of small plots within a large field will result in their destruction. Our objective was to relate pearl millet grain yields to head length and seed size measurements of undamaged panicles. This research was conducted on a Norfolk sandy loam located on the North Florida Res. and Educ. Ctr., Quincy FL with HGM-100 pearl millet hybrid. Three hundred and sixty HGM-100 panicles that were not damaged by birds were selected at random for three different lengths of panicle (15, 12, and 9 inches in length) for grain yield and linear regression analysis. The simple linear regression equation for predicting grain yield per head of bird damaged pearl millet research plots was: $Y = -0.0317 + 0.0048 X$, where Y = pearl millet head yield (lb/head) and X = head length (inches), $R^2 = 0.92$.

INTRODUCTION

Pearl millet is a potentially productive high-quality grain or silage crop (Burton et al.,1986 and Kumar et al., 1983). It is grown under low-input management conditions (noncrusting sandy soils with little fertilizer and limited water; Payne et al., 1990) and fits the summer growing season presently occupied by crops such as soybean [Glycine max (Merr.)], peanut [Arachis hypogeae L.], sorghum [Sorghum bicolor L. (Moench)], tropical corn [Zea mays L.], bahiagrass [Paspalum notatum (Flugge)], and bermudagrass [Cynodon dactylon L. (Pers.)] in year-round multiple cropping systems of the southeastern United States.

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Two major problems have been demonstrated in research with this potential new crop (Wright et al., 1993). First, the commercially available hybrid grain-type pearl millet, HGM-100 is a small seeded crop. This necessitates the need for uniform depth of planting which can be remedied by improved planter engineering and careful planter adjustment. Second, is the problem of the crops susceptibility to extensive bird damage to maturing panicles (the milk stage is the most susceptible stage), particularly in small plots (Wright et al., 1993).

Wright et al. (1993) experienced extensive bird damage to pearl millet in small plot research in 1992 and used a grain/silage-without grain ratio from an undamaged pearl millet herbicide study to estimate grain yield from other bird damaged research plots. This estimate was better than nothing, but a better predictor of bird damaged pearl millet yield was needed.

Estimating grain and forage crop yields has been demonstrated to be a function of the equation: $D = M/V$, where D = a measure of bulk density, M = mass, and V = volume (Teare and Mott, 1965 and Wilson and Teare, 1972).

The objective of this study was to find a pearl millet parameter, persistent after bird damage, for accurately predicting pearl millet grain yields from small-plot research to finish the research that had been successfully conducted up to the milk stage and bird predation.

MATERIALS AND METHODS

These studies were conducted in 1993 on a Norfolk sandy loam (fine, loamy siliceous, thermic Typic Kandiudult) located on the North Florida Research and Education Center, Quincy, Florida. The soil has a compacted layer located 8 to 14 inches below the surface.

The pearl millet hybrid used in this study was HGM-100, developed as a grain pearl millet by W.W. Hanna (1991), Tifton, Georgia. Pearl millet seed was no-till planted in a weed fallow field with a Brown Ro-Til implement with KMC planters in a

Table 1. Pearl millet grain yield, and grain size for six replications of each head length (9, 12, and 15 inch); Quincy, FL, 1993.

Rept.	Head length[1] (inch)	Grain size[2,4] (lb/1000 seeds)	Grain yield[3,4] (lb/head)
1	15	0.0150	0.0467
2	15	0.0139	0.0377
3	15	0.0139	0.0398
4	15	0.0142	0.0452
5	15	0.0146	0.0382
6	15	0.0135	0.0410
$\bar{x}$		0.0142 A	0.0414 A
1	12	0.0122	0.0225
2	12	0.0120	0.0220
3	12	0.0132	0.0221
4	12	0.0130	0.0218
5	12	0.0143	0.0299
6	12	0.0133	0.0314
$\bar{x}$		0.0130 B	0.0250 B
1	9	0.0109	0.0130
2	9	0.0086	0.0144
3	9	0.0102	0.0154
4	9	0.0109	0.0111
5	9	0.0095	0.0112
6	9	0.0090	0.0096
$\bar{x}$		0.0098 C	0.0124 C

[1] Three specific head lengths selected at random from non-bird-damaged pearl millet. Each replication is the mean of 20 pearl millet heads.

[2] Grain size (seed weight (lb/1000 pearl millet seed) of the three specific head lengths.

[3] Grain yield was collected for each 20 heads per replication, divided by twenty and expressed as yield/head.

[4] Mean values in columns followed by the same letter are not significantly different at the 5% level of significance.

completely randomized block design with six replications on 29 May 1993. Before the millet was planted, weeds were burned down with applications of Round-up (7 May) at 2 pt/A and Gramoxone (21 May) at 3 pt/A. Seed were planted 3/4" deep at 4 lbs/A (322 000 seeds/A planted) with an emergence of approximately 177 000 plants/A (55% emergence). Plots were 24' X 30' with eight rows 36" apart.

Five hundred lb of 5-10-15 fertilizer/A was applied on 15 May before planting. Ammonium nitrate was sidedressed to the side of the row at 120 lb N/A on 16 July. Prowl @ 1 qt/A + Atrazine @ 2 qt/A was used for weed control (Wright et al., 1993). Herbicides were applied between stage 1 (three leaf stage) and 2 (five leaf stage), about 12 days after planting when millet was between 3 and 5 inches tall.

Pearl millet heads were measured from top to bottom of panicle as illustrated in Fig. 1. Twenty pearl millet heads were carefully selected for each of three specific head lengths (9, 12, and 15 inch) and replicated six times. Concomitant measurements of head grain yields and counts of heads per unit area were then used for regression analysis. Pearl millet heads were harvested on 28 Sept, dried in a greenhouse, and threshed with a clover threshing machine that required 20 pearl millet heads per sample for the threshing operation.

Little rain occurred throughout the growing season for this rainfed experiment. A total of 19.0 inches of rainfall was recieved during the pearl millet growing season from 29 May to 28 Aug, 1993. Rainfall events and amounts are shown in Fig. 2.

RESULTS AND DISCUSSION

The null hypothesis that pearl millet grain yield per head could be predicted from head length measurements was tested in 1993. Six replications of 20 non-bird damaged pearl millet grain heads of specific lengths (15, 12, or 9 inches) were carefully threshed and grain yield per head and grain weight per seed were found to be significantly different for each head length (Table 1).

A simple linear regression equation was developed to predict head yield from head length: $Y = -0.0317 + 0.0048 X$, where Y = pearl millet

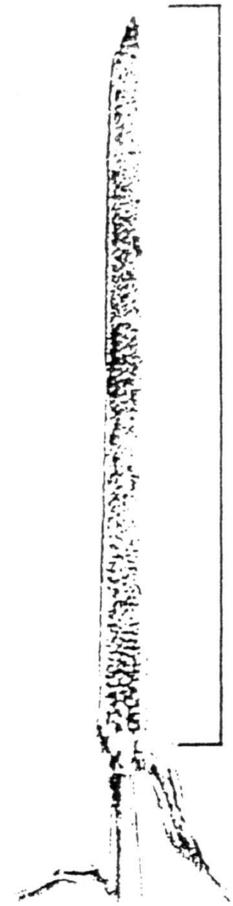

Figure 1. Length of pearl millet head measured as illustrated.

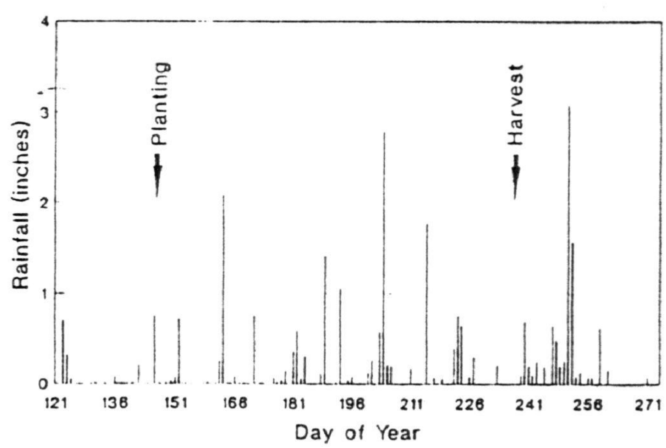

Figure 2. Rainfall during the 1993 pearl millet season in relation to rainfall amounts and dates of events.

grain yield (lb/head) and X = head length (inches) with a coefficient of correlation (r) = 0.96 and $\underline{P} < 0.0001$. A simple linear equation was also developed to predict head yield from grain size (lb/1000 seeds): $Y = -0.0421 + 5.5408 X$, where Y = pearl millet grain yield (lb/head) and X = lb/1000 seed with a coefficient of correlation (r) = 0.89 and $\underline{P} < 0.0001$.

Grain size (Y) was also predicted by head length: $Y = 0.0037 + 0.0007X$ with a coefficient of correlation (r) = 0.90 and $P < 0.001$.

When grain size (lb/1000 seed) and head length (inches) were used in a multiple regression analysis, the equation developed was: $Y = -0.0344 + 0.0043 X_1 + 0.7630 X_2$, where Y = pearl millet grain yield, X_1 = head length (inches) and X_2 = grain seed size (seed/lb) with a coefficient of determination (R^2) = 0.92 and $\underline{P} < 0.0001$.

We agree that the best measure of grain yield is from undamaged pearl millet heads per unit area, but using predictions of head grain yield from head length measurements of a specified unit area can salvage time-consuming small plot research that is more susceptible to bird depredation in the soft dough stage than when the pearl millet is grown in large fields. The most useful equation for predicting head grain yield is the simple linear regression where head length explains 92% of the variation in head grain yield. If all the head lengths are measured and number of heads counted in a unit area, then grain yields (bu/A) can be predicted from

$$\frac{\text{lb grain/head} \times \text{heads/A}}{56 \text{ lb/bu}}.$$

This equation is useful for salvaging valuable small plot research that has been subject to bird depredation.

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