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GRAIN PEARL MILLET AGRONOMIC PERFORMANCE IN RELATION TO CONVENTIONAL AND STRIP-TILLAGE

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ABSTRACT

Pearl millet [Pennisetum glaucum (L.) R.Br.] displays a potential of high production as a silage or grain crop. The 1993-1994 research was conducted in order to compare millet physiological traits and yields of fresh matter and grain in two tillage systems: conventional and strip-till (no-till plus in row subsoiling). The study was carried out on a Dothan sandy loam soil at the Quincy North Florida Research and Education Center. The seed used was millet hybrid HGM™100 developed by Hanna in Tifton, Georgia. Millet emergence was slightly better when planted strip-tilled than conventionally tilled in 1994. Higher tillering in the conventional tillage resulted in more stems per area unit. This was reversed in relation to number of grain heads per acre giving a higher amount for strip-tillage. Plant height was affected by tillage with taller plants for both years for strip-tillage. Grain head length was not influenced by tillage system. In 1993, fresh matter yield was statistically greater for strip-tillage. Strip-tillage produced slightly better grain yields than conventional tillage. In general, yields depended more on the weather pattern than tillage practice applied.

INTRODUCTION

Pearl millet [Pennisetum glaucum (L.) R.Br.] is a potentially productive grain and silage crop (Burton et al., 1986). It can yield well even under limited water supply (Smith et al., 1989) and limited fertilizer (Payne et al., 1990). However, Bationo et al. (1990) have shown that higher fertilization and plant density increased grain yield in average to wet years and only reduced it slightly in a dry year.

As a small seed species, millet requires a well prepared seed bed, but appears to emerge and grow well on strip-tillage. Wright et al. (1993) obtained higher grain and silage yields when millet seed was planted no-till with in-row subsoiling than when planted in conventionally prepared seed beds. The study produced millet yields of 2.7 ton grain/A and 18.5 ton silage/A which exeeded tropical corn yields that year (1.8 and 9.5 ton/A respectively). Wiatrak et al. (1994) reported that pearl millet yielded more in no-till than conventional tillage.

The objective of this two-year study was to compare pearl millet fresh matter and grain yields in strip vs. conventional tillage.

MATERIALS AND METHODS

The study of 1993-1994 was conducted on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudult) located on the North Florida Research and Education Center, Quincy, Florida. The soil features a compacted layer 8 to 14 inches below the surface. The seed used was grain pearl millet hybrid HGM™100 developed by W.W. Hanna in Tifton, Georgia. The 1993 study was planted in a winter fallow and the study of 1994 followed winter small grains. The 1993 study was irrigated with one inch of water after planting. There was no need to irrigate the study in 1994 because much rain occurred during the millet growing season that year (Figure 1).

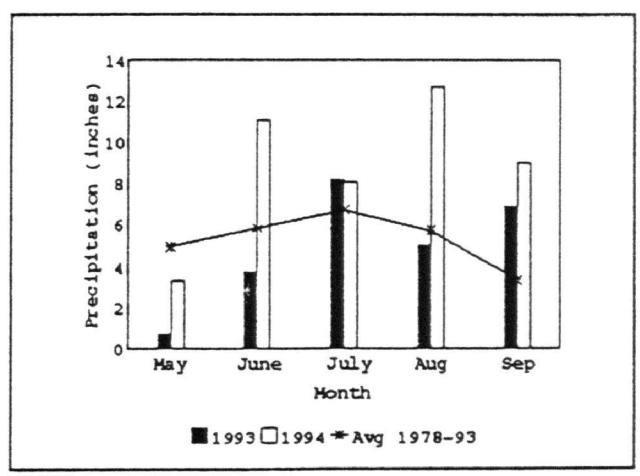

Figure 1. Precipitation in millet growing season (1993 & 1994) compared to 15 year average (1978-1993)

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In 1993 conventional tillage plots were first mowed then chisel plowed, disc harrowed and S-tined. No-tillage were only mowed preplant and Roundup applied at 2 qts/A preemergence and in 1994 Gramoxone was applied at 1.5 pt/A on the entire field. The conventional plots were planted at the same time as the strip tillage plots.

The row spacing was three feet with 6 lb seed planted per acre at 1/4 to 1/3 inch soil depths. Both years a total of 150 lb N/A as ammonium nitrate was applied in sidedress applications. In 1993, 50 lb N/A was applied at planting and 100 lb/A was applied when millet was 5-7" tall. In 1994, 75 lb N/A was applied when millet was 7" tall and 75 lb when the plants were 24" high. Millet was sprayed preemergence for weed control with Atrazine at 1.5 lb/A in 1993, and with Prowl at 1.5 pts/A plus Aatrex at 1 lb/A preemergence and a direct spray of Roundup at 2 pts/A when millet was 1.5' high in 1994.

Millet was cut for silage 75 days after planting in 1993 and 90 days after planting in 1994. Because of black bird damage grain yield was not harvested, instead grain yield was calculated using Pudelko et al. (1994) regression equation: $Y = -0.0317 + 0.0048x$, where Y = millet grain yield (lb/grain head), and x = grain head length (inches).

RESULTS AND DISCUSSION

Table 1 shows that no significant differences were found between the tillage systems in plant population, number of stems per acre, tillering index, and number of heads per acre in 1994. Strip-tillage resulted in 45,700 plants per acre, and tillage gave 40,900 plants/A. There was a higher tillering index for till plots, 3.2, than for strip-till, 2.6. This resulted in 125,400 stems per acre for conventional tillage, and 110,600 stems/A for strip-till. The number of grain heads per acre was higher, though, for strip till, 73,900, than for till, 71,900 heads/A.

Table 2 shows the results of 1993 and 1994 for average plant height, grain head length, and head number per acre as influenced by the two tillage systems. Average plant height was significantly higher for strip-tillage than for conventional tillage, 6.3 and 5.8 feet in 1993 and 4.3 and 3.8 feet in 1994, respectively. There was little difference in head length between the tillage systems. Head length varied greatly between years with 12.7 inches in 1993 and 9.4 inches in 1994. Grain head numbers per acre was higher both years on strip till plots than conventional plots. In 1993 there were 118,100 heads/A for till and 124,400 heads/A for strip-till, with the greatest variation between years. Because of cloudy weather and excessive rainfall, plant height, head length, and head population were approximately 33% lower in 1994 than they were in 1993.

Table 1. Influence of tillage on millet population characteristics (1994)

Parameter	Till	Strip-till
Initial Plant Population/A	40,900a	45,700a
Stems/A	125,400a	110,600a
Tillering index	3.2a	2.6a
Grain heads/A	71,900a	73,900a

Numbers in the same row followed by the same letter are not significantly different at P=0.05

Table 2. Pearl millet performance as influenced by two tillage systems (1993-1994)

Trait	Tillage system	1993	1994
Plant height (ft)	Till	5.8b	3.8b
	Strip-till	6.3a	4.3a
Head length (inches)	Till	12.7a	9.4a
	Strip-till	12.5a	9.3a
Heads/A	Till	118,100a	71,900a
	Strip-till	124,400a	73,900a

Numbers in the same column of each parameter followed by the same letter are not significantly different at P=0.05

Table 3 shows yield components in the 1993 and 1994 millet production. In 1993 fresh silage yield was significantly higher for strip-till, 48,168 lb/A, than for till, 42,816 lb/A, but in 1994 the difference in fresh matter yield was not significant. Though not significant dry silage yield in 1993 dry silage yield was slightly higher for till, 12,042, than for strip-till, 11,774 lb/A, but strip-till did better than till in 1994. Average grain yields were three times higher in 1993 than 1994, but the difference between tillage

treatments was not significant. Strip-till yielded slightly more than till both years.

Table 3. Millet fresh matter and grain yield (1993-1994).

Yield component	Tillage system	1993	1994
Fresh matter (lb/A)	Till	42,816b	12,910 a
	Strip-till	48,168a	16,730 a
Dry matter (lb/A)	Till	12,042a	3,000a
	Strip-till	11,774a	3,783a
Grain (bu/A)	Till	63.0a	19.0a
	Strip-till	66.3a	19.7a

Numbers in the same column of each parameter followed by the same letter are not significantly different at P=0.05

Generally, strip-tillage was the same or slightly better in agronomic performance for millet than conventional tillage. The impact of weather, however, was much greater and caused a dramatic yield reduction due to cloudy and rainy conditions of 1994.

CONCLUSIONS

1. There was a tendency for better emergence with strip-tillage as compared to till in 1994 when conditions were wet.
2. More tillering occurred in conventional tillage but with less well-formed grain heads.
3. Plants were significantly taller on strip than conventional-till plantings.
4. Tillage did not influence grain head length.
5. Strip-tillage gave significantly higher fresh matter yield only in 1994.
6. Tillage did not influence millet grain yield.

REFERENCES

Bationo, A., C.B. Christanson, and W.E. Baethgen. 1990. Plant density and nitrogen fertilizer effects on pearl millet production in Niger. Agron. J. 82: 290-295.

Burton, G.W., A.T. Primo, and R.S. Lowrey. 1986. Effect of clipping frequency and maturity on the yield and quality of four pearl millet. Crop Sci. 26: 79-81.

Payne,W.A., C.W. Wendt, and R.J. Lascano. 1990. Root zone water balance of three low-input millet fields in Niger, West Africa. Agron. J. 82: 813-819.

Pudelko, J.A., D.L. Wright, I.D. Teare, and D.W. Reeves. 1994. Adjusting grain yield of bird damaged pearl millet. 1994 South. Cons. Till. Conf. for Sust. Agric.: 199-202.

Smith, R.L., C.S. Hoveland, and W.W. Hanna. 1989. Water stress and temperature in relation to seed germination of pearl millet and sorghum. Agron. J. 81: 303-305.

Wiatrak, P.J., D.L. Wright, J.A. Pudelko, and B.T. Kidd. 1994. Comparison of tillage methods on pearl millet and tropical corn for silage and grain.p.131-136. In P.S.Bauer and W.T.Busscher (Ed.)1994 South. Cons. Till. Conf. for Sust. Agric. June 7-9, Columbia, S.C. SB 94-1.

Wright, D.L., I.D. Teare, F.M. Rhoads, and R.K. Sprenkel. 1993. Pearl millet production in a no-tillage system. p. 152-159. In P.K. Bollich (Ed.) 1993 South. Cons. Till. Conf. for Sust. Agric.