RESIDUAL PHOSPHORUS AND pH EFFECTS ON PEARL MILLET GRAIN PRODUCTION

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ABSTRACT

Field tests were conducted during 1992-1994 in south Alabama to evaluate the response of pearl millet (*Pennisetum glaucum* (L.) R. Br.) to soil pH and residual P when grown in rotation with white lupin (*Lupinus albus* L.). The test was conducted on a Benndale sandy loam (Typic Paleudults) and a Lucedale fine sandy loam (Rhodic Paleudults). The experimental sites had been part of a previous long-term study to evaluate crop response to soil pH and annual P rates. No P had been applied since 1980 and each site had a wide range in soil pH and soil test P. In 1993 excellent grain yields were obtained with the better treatments yielding 3005 lb/A on the Lucedale soil and 5291 lb/A on the Benndale soil. For this test the optimum pH for millet grain production was in the range of 6-6.5. Millet responded to the level of soil test P up to a level that would be "high" according to the Auburn University Soil Testing Laboratory.

INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of several crop species that are being evaluated as possible alternative crops in the Southeast. Recent breeding efforts (Hanna, 1991) have resulted in the production of pearl millet hybrids that produce high yields of high quality grain (Kumar et al., 1983). In the Southeast pearl millet could be grown in double cropping systems following wheat (*Triticum aestivum* L.) or other winter crops. Pearl millet is reported to grow well under water limited conditions, which suggests that pearl millet could be an attractive crop for the Southeast since this area frequently experiences short term periods of drought stress in July - September.

Pearl millet is considered to be well adapted to highly weathered acidic soils and has been shown to be more tolerant of aluminum toxicity than sorghum (*Sorghum bicolor* (L.) Moench) (Ahlrichs et al., 1991). It may be well suited for the Southeast since the soils in this region are naturally acidic and highly weathered.

In the Southeast there is little if any information available describing the response of pearl millet to available soil P and soil acidity. This field test is being conducted in southern Alabama to evaluate the response of pearl millet to soil pH and residual soil P when grown in rotation with white lupin (*Lupinus albus* L.).

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MATERIALS AND METHODS

Field studies were conducted on experimental sites that were established in 1971 (Adams et al., 1982). The experiments were established on a Benndale sandy loam (coarse-loamy, siliceous, thermic Typic Paleudults) located at Brewton, AL and a Lucedale fine sandy loam (fine-loamy, siliceous, thermic Rhodic Paleudults) located at Monroeville, AL. The original experiment included four soil pH levels and five annual rates of P (0 to 350 lb P/A). No fertilizer P has been added since 1980. At each site three or four pH ranges are currently bracketed and plots within a given pH range have a wide range in extractable P (Fig. 1 and Fig. 2). According to the Auburn Soil Testing Laboratory (Adams et al., 1994) a "high" soil test rating would correspond to a soil test P range of 51 to 100 lb/A of Mehlich I extractable P. Since 1980, K has been added periodically according to soil test recommendations and agricultural limestone has been added to maintain a range in soil pH values.

During 1991-1994 the areas were placed in a lupin-pearl millet rotation. White lupin ('Tifwhite 78' or 'Lunoble') was planted in the fall of 1991 and 1992. Both experimental areas were left fallow during the winter-spring of 1993-1994. Grain yields of lupin were determined by mechanically harvesting the two center rows from each plot.

Pearl millet was planted in the spring of each year after the harvest of lupin for grain. Millet (AgraTech Seeds Inc., hybrid 'HGM™100') was seeded at a rate of 4 lb/A using 36 inch rows. Nitrogen was applied at a rate of 50 lb/A. At maturity in 1992 the two center rows of each plot were picked mechanically. Due to obvious bird damage, yields were estimated in 1993. In 1993, yields were estimated by covering 10 millet heads in each plot with paper bags at flowering. At maturity these heads were harvested by hand for the determination of head length, yield per head and yield per unit length of head. Plot yields were estimated by counting the number of heads in a 10 foot section of row in each plot and calculating the estimated grain yield based on the determined yield of grain per head.

RESULTS AND DISCUSSION

Millet grain yields in 1992 were low at both locations (Fig. 1 and Fig. 2), ranging from 390 to 1880 lb/A. Low yields were attributed to bird damage that occurred prior to harvest. At Brewton the lowest yields were obtained at a pH of 4.7 (Fig. 1), but there was no effect of pH on yield once the pH was above 5. Millet yields increased with soil test P up to approximately 50 lb/A (i.e. up to a "high" soil test rating according to the Auburn Soil Testing Laboratory). Yields tended to decrease with test P > 50 lb/A at a pH of 6.4. At Monroeville in 1992, highest yields were obtained at a pH of 6.0 (highest pH; Fig. 2) while lowest yields were observed at a pH of 5.1 (lowest pH). At soil pH values of 5.5 and 5.1 grain yields tended to decrease with increasing soil test P.

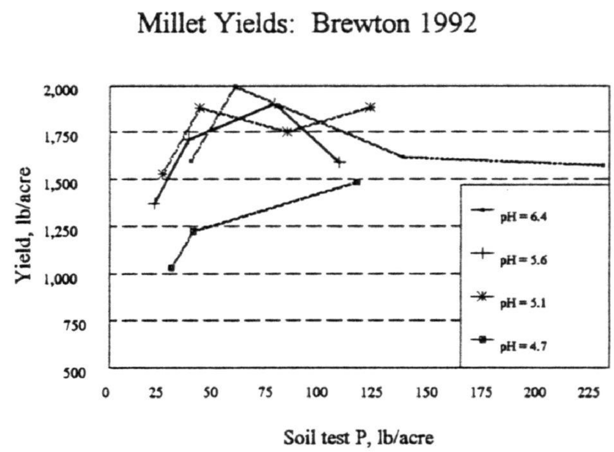

Fig 1. Millet grain yields in 1992 at Brewton (Benndale soil) as affected by residual fertility.

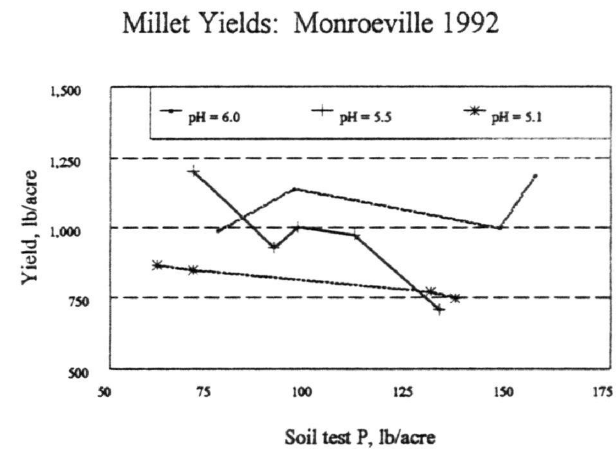

Fig. 2. Millet grain yields in 1992 at Monroeville (Lucedale soil) as affected by residual fertility.

In the fall of 1992 agricultural limestone was added at both locations to ensure that soil pH ranged from approximately 5.2 to 7 at both sites. In 1993 yields at both locations were much higher (Fig. 3 and Fig. 4) as compared to 1992 (Fig. 1 and Fig. 2). Higher yields in 1993 were attributed in part to better protection of harvested heads from bird damage in 1993. Millet responded to soil test P at all three soil pH levels at Brewton (Fig. 3). Yields were reduced somewhat when the pH was 5.2 as compared to 6.4. The lowest yields were obtained when the pH 7.1.

Millet Yields: Brewton 1993

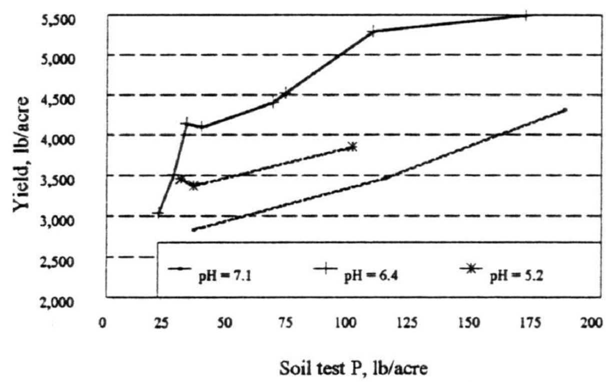

Fig. 3. Millet grain yields in 1993 at Brewton (Benndale soil) as affected by residual fertility.

Millet Yields: Monroeville 1993

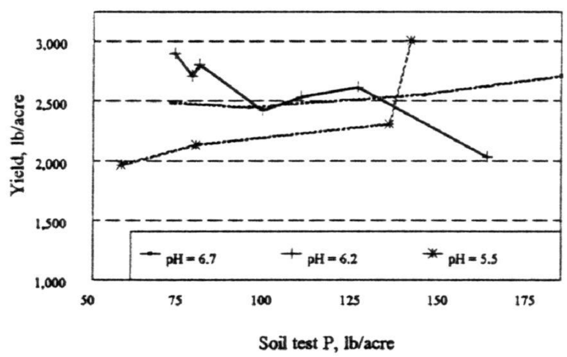

Fig. 4. Pearl millet grain yields in 1993 at Monroeville (Lucedale soil) as affected by residual fertility.

The response of millet to residual fertility treatments at Monroeville in 1993 were inconsistent (Fig. 4). At lower levels of soil test P, yields were reduced slightly at a pH of 5.5 as compared to 6.2 and 6.7. For some unexplained reason, there was a reduction in yield on this soil at pH 6.2 with increasing soil test P.

In 1993 millet yields at both locations were estimated by using the average weight of grain produced by pearl millet heads that were protected from bird damage. Analysis of data generated from the protected millet heads suggests that yield produced per unit of head length should be determined on a site basis. Data taken from the heads that were protected from birds at the Brewton site, showed that the grain yield per unit head length (Fig. 5) was dependent on soil pH and level of soil test P. Yield per unit head length at Monroeville was not affected by the residual treatments. Head length in 1993 was not affected by the residual fertility treatments at either location and averaged 11.6 inches at Brewton (Benndale soil) and 9.6 inches at Monroeville (Lucedale soil).

Yield/cm Head: Brewton 1993

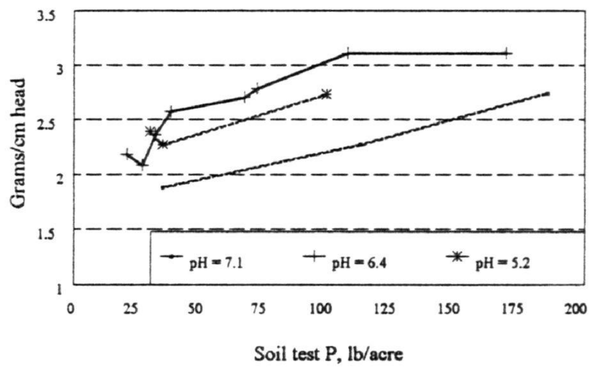

Fig. 5. Grain yield per cm of head length on Benndale soil in 1993.

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