

Influence of Tillage, Previous Crops and N Rates on Pearl Millet

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Abstract: Two experiments were conducted in 1994 and 1995 on a Dothan sandy loam (fine, loamy siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL. The first experiment was conducted to test the influence of previous crops [white lupin (*Lupinus albus* L.) and wheat (*Triticum aestivum* L.)], and four Nitrogen rates (N rates: 0, 60, 120 and 180 lb. N/A) on silage yield, % Nitrogen in silage and grain yield of pearl millet [*Pennisetum glaucum* (L.) R. Br. HGMTM 100]. The second experiment was conducted to test the influence of strip tillage and conventional system, previous crops (white lupin and wheat), and Nitrogen rates (0, 60, 120, and 180) on pearl millet. In the first experiment the grain yields of pearl millet were higher in 1995 than in 1994 (2859.3 lb./A versus 991.8 lb./A); this was due to extremely high rainfall (88.2 inches) and low light conditions of 1994. There were no statistical differences at the 95% confidence limit between white lupin and wheat in grain yields of pearl millet following these crops in 1994 (924.9 and 1058.8 lb./A respectively), but the calculated grain yields of pearl millet were higher after white lupin than wheat in 1995 (3113.5 lb./A versus 2605.1). The silage yields of pearl millet in the first experiment were higher in 1995 than in 1994 (10.6 and 4.6 T/A respectively) due to weather conditions as explained above, and higher after white lupin than wheat. In the second experiment grain yields of pearl millet were not statistically different for tillage systems, but they were higher after white lupin than wheat (1603.7 versus 1386.0 lb./A). Silage yield of pearl millet in the second experiment were statistically higher in strip tillage than conventional tillage and they were higher after lupin than after wheat. The percent N in silage of pearl millet was different between years and between previous crops and it was significantly higher after white lupin than wheat; but it was not significantly different for tillage systems. The differences in percent N in silage of pearl millet between 1994 and 1995 were also due to weather conditions.

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is grown today as a food crop on 64 million acres in semi arid tropics (Andrews and Rajewski, 1995). It is the most reliable staple cereal for sandy soils of hot, drought prone (low rainfall) regions. Pearl millet grain is nutritious with higher protein and lysine levels than corn or sorghum. This plant has been used only as a forage crop in the U.S. until recent breeding developments began to exploit its potential as a grain crop for U.S. agricultural systems. (Rajewski and Andrews, 1995). Pearl millet can be grown for silage and grain in multicropping systems, when too late to plant temperate corn. When grown

in a strip till system it gave a higher yield of fresh silage than in a conventional system. However the fresh matter contained less dry matter in the strip tillage system than in the conventional tillage, therefore dry matter yields were not statistically different (Wiatrak et al., 1994). Green forage was higher for pearl millet than for corn and dry matter yield of conventionally planted pearl millet was significantly higher than dry matter of conventionally planted corn.

Bationo et al. (1990) showed that increasing fertilization and plant density increased grain yield of pearl millet in average or wet years and slightly reduced yield in drought year. Powell and Fussell (1993) have shown the importance of fertility on DM, N, P, and structural carbohydrate distribution in plant parts of pearl millet. Fertilizer N [45 kg/ha (40.1 lb./A)], increased total millet DM by 13%, N uptake by 63%, and P uptake by 29%. Fertilizer P [17.4 kg/ha (15.5 lb./A)] increased total millet DM by 100%, N uptake by 80%, and P uptake by 140%.

The objectives of the study were to compare different tillage systems, previous crops and N fertilizer on silage and grain yield of pearl millet.

Materials and Methods

The research was conducted in 1994 and 1995 on a Dothan sandy loam (fine-loamy, siliceous, thermic Plinthic Kandiudults) at the North Florida Research and Education Center, Quincy, FL.

The experimental design was a split-plot (main plots were previous crops and sub-plots were N fertilizer rates for pearl millet) with four replications. The N fertilizer treatments were: 0, 60, 120, 180 lb. N/A. In the first experiment the influence of two previous crops (white lupin and wheat) on response of pearl millet to N fertilizer rates was determined. The influence of tillage systems (strip tillage and conventional

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system), previous crops (white lupin and millet), and Nitrogen rates (0, 60, 120, and 180 lb./A) on response of pearl millet were evaluated in the second experiment. The pearl millet hybrid used in this study was Agra Tech HGM™100 developed by W.W. Hanna from Georgia.

Exp. 1

This was a two-year experiment in which the plots after white lupin and wheat were rotary moved and broadcast sprayed with Gramoxone @ 1 pt/A + Induce @ 1 pt/100 gal. H₂O to control the weeds. On June 27 and 28, 1994 and June 21, 1995 the Gandy fertilizerspreeder was used to broadcast all plots with 0-0-60 (Muriate of Potash) @ 150 lb./A and 0-46-0 (Triple Super Phosphate) @ 100 lb./A. Pearl millet was planted with a Brown Ro-till implement and KMC planters @ 6 lb./A on June 29, 1994 and June 23, 1995. The day after planting pearl millet was broadcast sprayed with Aatrex @ 1 lb. A.i./A + Prowl @ 1 pt/A. Irrigation was applied at 1/2" @ 1/4" on June 28 and August 17, 1995. Fertilizer was applied to pearl millet to supply 1/3 of each N rate two to three inches beside the crop row on July 1, 1994 and June 26, 1995, and 2/3 of each N rate on July 20, 1994 and July 18, 1995. On July 22, 1994 and July 17, 1995 a Redball hooded sprayer was used to direct spray Gramoxone @ 1 pt/A + Induce @ 1 pt/100 gal. H₂O between the rows to control the weeds. The same day pearl millet was broadcast sprayed with Lorsban @ 2 pt/A + Dipel @ 1 pt/A + Sunspray oil @ 2 pt/A to control the insects. PennCap M @ 2 pt/A was broadcast sprayed on pearl millet to control the stinkbugs on August 22, 1994. On September 7 and 8, 1994 the experiment was irrigated with 1/2" @ 1/4" H₂O. PennCap M @ 2 pt/A + Lannate @ 2 pt/A were broadcast sprayed to control the insects on September 13, 1994. On September 14, 1994 and September 5, 1995 pearl millet at the soft dough stage was cut for silage with the Hesston silage chopper. Due to birds eating the grain before it could be harvested, Dr. Pudelko's formula (Pudelko et al., 1995) was used to calculate the grain yield of pearl millet. In order to calculate the grain yields of pearl millet, the lengths of 20 grain heads were measured and the number of grain heads counted on 20 feet of row.

Exp. 2

This experiment with pearl millet was conducted in 1994 only. The conventional section of the experiment was disc-harrowed (2x) and s-tine harrowed (2x) on June 28. On July 12 all plots after white lupin and wheat were mowed. All plots were broadcast sprayed on July 15 with Gramoxone @ 1/2 pt/A + Aatrex @ 1 lb. A.i./A + Prowl @ 1/4 pt/A. On July 26 pearl millet was planted 1/4 inch deep with a Brown Ro-till implement and KMC planters @ 6 lb./A. Pearl millet seedlings emerged on August 1. On August 8 nitrogen was applied on treatments receiving 60, 120 and 180 lb. N/A (the 180 treatment got only 120). Four weeks later 60 lb. N/A was put on the 180 lb. N/A treatment. Pearl millet was cut for silage on September 29. The length of 20 grain heads

was measured and the number of grain heads on 20 feet of row was counted from each treatment in order to calculate grain yield of pearl millet.

The results of the experiment were analyzed statistically by analysis of variance using SAS (SAS Institute, Inc., 1987), and means were separated using Fisher's Least Significant Difference Test at the 5% probability level.

Results

Exp. 1

There were significant differences in silage yields (4.6 and 10.6 T/A), and grain yields of pearl millet (2859.3 and 991.8 lb./A respectively) between 1994 and 1995; therefore, data was analyzed separately. Rainfall was excessive in 1994, with 88.2 inches for the year. This increased the potential for leaching of N and reduced light intensity due to higher number of cloudy days. Therefore reduced yields in 1994 were possibly due to N deficiency as a result of leaching and reduced light and photosynthesis. In 1994 silage yields of pearl millet (Fig. 1) were increasing with N rate, but this increase was higher after white lupin than after wheat (averages 5.3 and 3.9 T/A respectively). In 1995 (Fig. 1) silage yields of pearl millet were not significantly different for previous crops, but silage yield of pearl millet responded to N rate and was highest at 150.0 lb. N/A (12.5 T/A). The low silage yield response to N rates in 1994 supports the hypothesis that leaching of N reduced yields that year.

There was an interaction between the year and previous crop for the percent of nitrogen in pearl millet silage. The interaction was shown by a reversal nitrogen in pearl millet silage. The percent N was statistically higher after lupin than wheat in 1995 (1.537 and 1.415% respectively) (Tab. 1.). In 1994 there were no statistical differences for previous crops and N rates, therefore the results are shown for 1995 (Fig. 2). The lack of response of N content to N rates also supports the hypothesis that N leaching reduced yield in 1994. In 1995 the percent N for pearl millet silage was the highest after white lupin (Fig. 2) at 157.5 lb N/A (1.67% N) and was slightly decreased with higher than 157.5 lb. N/A. The percent N for pearl millet silage was statistically lower after wheat (avg. 1.41% N) when compared to percent N in silage of pearl millet grown after white lupin (avg. 1.54% N) in 1995.

The calculated grain yields of pearl millet (Fig. 3) were higher in 1995 (avg. 2859.3 lb./A after white lupin and wheat) than in 1994 (avg. 991.8 lb./A after white lupin and wheat). In 1994 grain yields of pearl millet were not significantly different for previous crops (924.9 lb./A after wheat and 1058.8 lb./A after white lupin), therefore the data for this year was combined for previous crops. In 1995 the grain yields of pearl millet were significantly higher after white lupin than after wheat (avg. 3113.5 versus 2605.1). The response of pearl millet to Nitrogen was not significantly different after lupin; therefore the results for grain yield of pearl millet after wheat are shown only for 1995 (Fig. 3). Grain

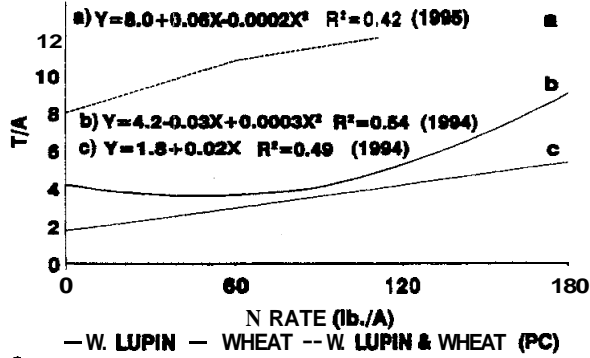


Fig. 1. The silage yields of pearl millet after white lupin and wheat in 1994 and 1995 (Exp. 1).

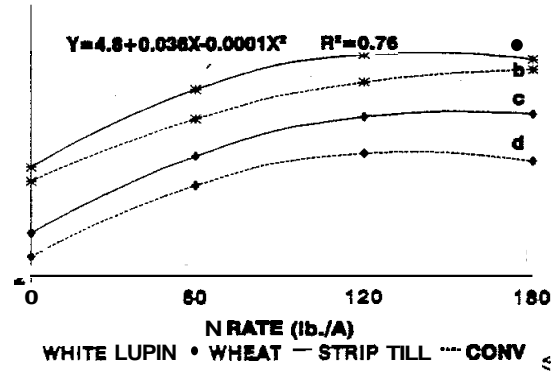


Fig. 4. The silage yields of pearl millet in strip till and conventional system, and after white lupin and wheat in 1994 (Exp. 2).

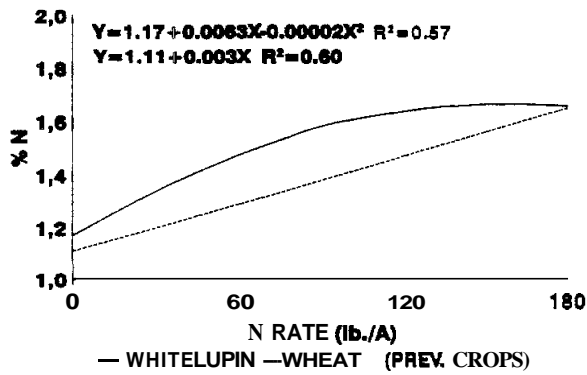


Fig. 2. The percent of nitrogen in pearl millet silage after white lupin and wheat in 1995 (Exp. 1).

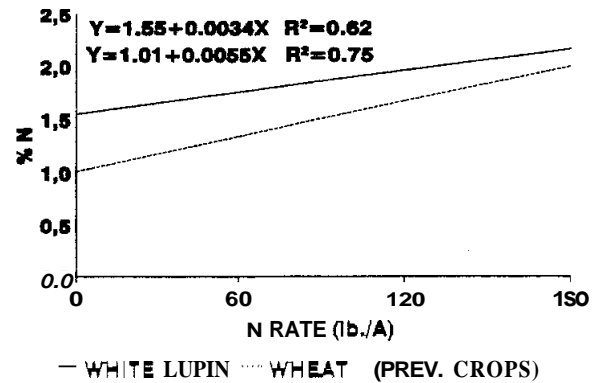


Fig. 5. The percent of nitrogen in the silage of pearl millet after white lupin and wheat in 1994 (Exp. 2).

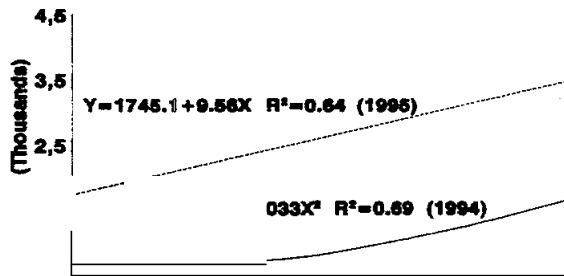


Fig. 3. The grain yields of pearl millet after white lupin and wheat in 1994 and 1995 (Exp. 1).

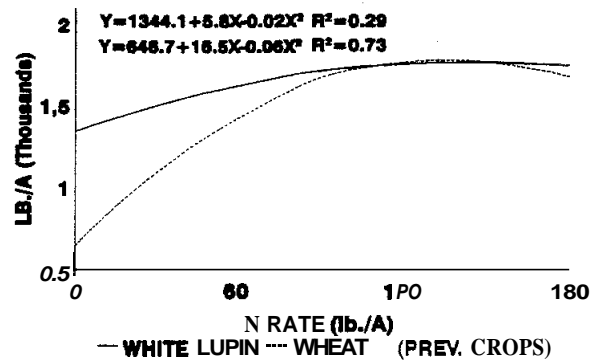


Fig. 6. The grain yields of pearl millet after white lupin and wheat in 1994 (Exp. 2).

Table 1. Percent of nitrogen in silage of pearl millet in 1994 and 1995 after white lupin and wheat.

PC/Year	1994	1995	Mean
White Lupin	1.459	1.537	1.498
Wheat	1.609	1.415	1.512
Mean	1.534	1.476	

LSD(0.05) for PC - NS

LSD(0.05) for Year - NS

LSD(0.05) for PC x Year - 0.1884

yields of pearl millet were higher with higher N rates in 1994 and 1995. However, the weak response of grain yield to N rates in 1994 further supports the hypothesis of yield loss due to leaching of nitrogen.

Exp. 2

In this experiment the influence of two tillage systems (strip till and conventional system), two previous crops (white lupin and wheat) and four nitrogen rates (0, 60, 120 and 180 lb. N/A) were analyzed for silage yields, percent N in silage and grain yields of pearl millet. The silage yields of pearl millet (Fig. 4) were significantly different at 95% confidence for tillage systems and previous crops. For all cropping systems the silage yields of pearl millet were increasing with increasing N rates. The silage yields of pearl millet were higher after strip tillage than after conventional tillage, and higher after white lupin than after wheat. The highest silage yields of pearl millet in strip tillage were obtained at N rates of 141 lb. N/A after wheat and 153 lb. N/A after lupin (8.6 and 6.8 T/A of silage respectively). Silage yields of pearl millet in the conventional system were highest at the rate of 180 lb. N/A after white lupin and 137 lb. N/A after wheat (8.0 and 5.6 T/A of silage respectively). The percent N in silage of pearl millet (Fig. 5) was not different between tillage systems, therefore data for tillage systems was combined. Percent N in silage of pearl millet was significantly higher after white lupin than after wheat (avg. 1.85 and 1.50% N respectively).

The grain yields of pearl millet (Fig. 6) were not significantly different between tillage systems at 95% confidence limit, but they were different between white lupin and wheat. The highest grain yields of pearl millet (calculated using Pudelko's formula) were obtained at the rate of 145 lb. N/A and 137 lb. N/A (after white lupin and wheat respectively).

Conclusions

1. The silage yield of pearl millet was higher after white lupin than after wheat and it was also higher with higher N rates applied to pearl millet.

2. The percent N in silage of pearl millet was dependent on the year and previous crop and it was generally higher

with increasing rates of Nitrogen applied to pearl millet.

3. The grain yields of pearl millet were higher with increasing N rates applied to pearl millet, and higher after white lupin than after wheat.

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