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Total Alkaloid and Nitrate Content of Eleven Pearl Millet Lines

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SUMMARY

Eleven forage-type pearl millet lines were grown during the summer of 1980, sampled, and analyzed for total alkaloid and nitrate content. Millet leaves (making up 62% of the whole plant sampled) contained more total alkaloid and less nitrate than stems. Large differences in alkaloid and nitrate content existed between the millet lines. Alkaloid content increased six-fold from the lowest to the highest entry, and nitrate content increased four-fold over the same span. Each pearl millet line ranked similarly for alkaloid and nitrate content; alkaloid and nitrate accumulation occurred simultaneously in this study. Drought tolerant entries accumulated higher levels of alkaloid and nitrate than the other entries.

Introduction

Pearl millet is frequently planted in late spring to provide mid-summer annual grazing for young growing cattle or for lactating dairy cows. It has been reported that pearl millet became unpalatable when growing under apparent drought stress conditions in East Texas. Laboratory analyses revealed that the unpalatable millet forage contained higher than normal levels of total alkaloids and potentially toxic levels of nitrates. The primary objectives of this study were to: (1) examine factors which may affect alkaloid and nitrate accumulation in pearl millet forage; (2) determine if alkaloid and nitrate levels varied between different pearl millet breeding lines; and (3) ascertain if alkaloids and nitrate indeed accumulate simultaneously in these breeding lines.

Procedures

The pearl millet lines included in this study were:

1. Millex 24¹ - hybrid pearl millet
2. Tift 23DA² - female parent of many pearl millet hybrids in U.S.
3. Tift 23B trichomed - normal pearl millet

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¹Courtesy of Northrup-King Seed Co.

²Lines 2-11 courtesy of Dr. W. W. Hanna, Research Geneticist, USDA Coastal Plain Experiment Station, Tifton, GA 31794.

4. Tift 23B trichomeless - smooth mutant that shows drought tolerance (identical to 23B trichomed except for tr gene)
5. Tifleaf 1 - hybrid
6. Gahi 3 - hybrid
7. Inbred 383 - male parent of Tifleaf 1
8. Inbred 186 - male parent of Gahi 3
9. 78-10414-6 - drought tolerant experimental line
10. 78-9815-10 - drought tolerant experimental line
11. 78-10294-1 - drought tolerant experimental lines

The lines were seeded on June 24, 1980 at 20 lb/acre on an upland Darco soil. The lines received 100 lb/acre each of N, P₂O₅, and K₂O at planting, plus an additional 50 lb/acre N on July 29, 1980. Millet samples were taken on August 8, 1980, divided into leaf and stem components, and analyzed for total alkaloid and nitrate content. Total basic alkaloids were extracted and measured by titration with p-toluenesulfonic acid. Nitrate levels were determined with a specific ion electrode.

Results

Mean leaf alkaloid content for the 11 millet lines, 89 ppm total alkaloid, was significantly higher than the mean stem content, 20 ppm (P<0.01). Mean leaf nitrate content, 3,859 ppm nitrate, was significantly lower than the mean stem content, 10,830 ppm (P<0.01). Pearl millet line alkaloid levels differed significantly (P<0.05) (Table 1). Line nitrate levels also differed significantly (P<0.05) (Table 2). The millet lines ranked similarly for alkaloid and nitrate content, and were significantly and positively correlated (r = 0.45, P<0.01). Of particular interest is that Tift 23DA, female parent of many U.S. millet hybrids, falls into the highest alkaloid and nitrate range. Also of importance is that three out of four drought tolerant entries rank in the highest alkaloid range, and all four entries appear in the highest nitrate range. Thus, in this study, alkaloid and nitrate levels differ between millet lines, and these antiquality agents accumulate simultaneously. Also, lines showing more drought tolerance seem to accumulate higher levels of total alkaloid and nitrate. None of the line nitrate levels entered the accepted potentially toxic range, which begins at about 15,000 ppm nitrate.

Table 1. Whole plant alkaloid content for 11 pearl millet lines.

<u>Line</u>	<u>Whole Plant Alkaloid Concentration (ppm)</u>
Tift tr 23B	121 a
Inbred 186	112 ab
78-10294-1	99 abc
78-9815-10	77 abc
Gahi 3	73 abc
Tift 23DA	54 abc
Tift Tr 23B	47 abc
Tifleaf 1	37 bc
Millex 24	29 c
Inbred 383	27 c
78-10414-6	20 c

^{abc} Alkaloid contents followed by the same letter are not significantly different at the 0.05 level using Duncan's New Multiple Range Test.

Table 2. Whole plant nitrate content for 11 pearl millet lines.

<u>Line</u>	<u>Whole Plant Nitrate Concentration (ppm)</u>
Tift tr 23B	9809 a
78-10294-1	8356 ab
78-9815-10	7969 ab
Tifleaf 1	7261 ab
Tift 23DA	7238 ab
78-10414-6	6825 ab
Inbred 186	5747 abc
Gahi 3	5691 abc
Tift Tr 23B	4892 bc
Millex 24	4877 bc
Inbred 383	2406 c

^{abc} Nitrate contents followed by the same letter are not significantly different at the 0.05 level using Duncan's New Multiple Range Test.