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Pearl Millet
A Potential Crop for Kansas

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Pearl millet, *Pennisetum americanum* (L.) Leeke, is a robust, annual bunchgrass that is grown on more than 35 million acres in the world, mainly in the semi-arid tropics. It is particularly well adapted to nutrient-poor, sandy soils and low rainfall, but improved varieties respond to good cultural conditions. It is recognized as one of the most drought resistant cereals and appears to be as heat tolerant as sorghum. Research is being conducted in Kansas to increase pearl millet's potential as a cereal crop in semi-arid, grain producing areas.

Description

The growth and development of pearl millet are similar to those of grain sorghum. The plant is an annual that tillers freely and varies in height from less than 3 feet to 15 feet. Heads are stiff and compact, cylindrical or spindle-shaped, 1 to 3 inches in diameter, and 2 to 30 inches long (Figure 1). Seed colors include blue, slate, brown, yellow, and white. Seed sizes range from one-quarter to one-half the size of sorghum seeds.

Pearl Millet Breeding

Pearl millet breeding and research were started in 1969 at Kansas State University, Manhattan and in 1971 at the Fort Hays Branch Experiment Station. The work has progressed through initial screening of

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over 2300 lines and varieties (obtained from the Southern Regional Plant Introduction Station, the World Collection, the ICRISAT Germplasm Collection, the USDA Collection, and several tropical countries) to the present stages of development of several populations, composites, and dwarf, early-maturing hybrids and inbred lines.

In order for millet to be grown successfully in the drier temperate zones at latitudes as far north as Kansas, it is necessary to convert the tropical, photoperiod-sensitive materials to early-maturing types that can flower and reproduce under day length, precipitation, and temperature conditions of this area. It is also necessary to introduce dwarfness, increased seed size, lodging resistance, and uniform ripening to enable the crop to be grown with mechanical farming methods.

Yield Evaluations

Yield tests were conducted from 1979 to 1982 at various locations throughout Kansas: Manhattan, Hutchinson, St. John, Hays, Minneola, Garden City, and Tribune. Eighteen Kansas experimental millet hybrids were tested and compared to commercial sorghum hybrids (three in 1979 and 1980; six in 1981 and 1982). The millet hybrids had maturity ratings comparable to those of sorghum hybrids used. Table 1 lists the average yield (lbs./acre) of sorghum and millet at each location for each year.

Some of the millet hybrids produced grain yields as high as 4800 lbs./acre. Millet hybrid 80-2113 × 79-1137, developed at Fort Hays, had an average yield of 2970 lbs./acre over all locations across both 1981 and 1982. This dwarf hybrid had one of the largest seed weights and averaged 55-59 days to half bloom. The highest yielding millets for all locations were 5-10 days earlier in maturity than the earliest sorghums used. The four-year average yield of all millets was 65% of the average yield of the commercial sorghum hybrids (Table 1). However, the four-year average yield of the top three millets was 84% of the average yield of sorghum.

Sorghum had better stand establishment and plant population, but millet had a greater tillering ability to compensate for lower plant populations. At harvest, millet had the greater number of heads per acre.

Seed weight of millet was about one-quarter to one-half that of sorghum. Sorghum seed weight varied more with changing environmental conditions than that of millet.

Studies also showed the water-use efficiency

Figure 1. Pearl millet heads.

Table 1. Yield of pearl millet compared to sorghum, 1979-1982.

1979 (lbs./acre)

Crop	Manhattan	Garden City	Hays	Minneola	St. John	Tribune	Avg.
Sorghum	6057	3443	4454	3092	1939	4663	3941
Millet	293	2047	3113	2188	1594	2999	2479
Avg. Top 3 Millets	3516	3095	2761	2761	2160	3930	3037

1980 (lbs./acre)

Crop	Manhattan	Garden City	Hays	Minneola	St. John	Tribune	Avg.
Sorghum	2201	1194	2550	2593	1307	4067	2318
Millet	1801	761	1468	2053	1364	3598	1840
Avg. Top 3 Millets	2641	1016	2106	2523	1736	4625	2441

1981 (lbs./acre)

Crop	Manhattan		Hays	Minneola	St. John	Tribune	Avg.
	Dry	Irrig.					
Sorghum	6949	7271	5140	4898	2178	5582	5336
Millet	3343	3099	3872	2665	1762	1906	2774
Avg. Top 3 Millets	4898	4442	4218	3679	2527	3196	3826

1982 (lbs./acre)

Crop	Manhattan		Garden City	Hays	Hutchinson	Minneola	St. John	Tribune	Avg.
	Dry	Irrig.							
Sorghum	4398	5032	2621	4126	2786	2927	3576	2075	3442
Millet	3114	3747	2181	3209	1985	2464	2065	1336	2512
Avg. Top 3 Millets	3862	4253	2491	3725	2222	2913	2468	1944	2984

(yield/water use) of sorghum to be greater than that of pearl millet, both for grain and total dry matter, even though sorghum used slightly more water than pearl millet. The primary reason for this greater efficiency by sorghum was its higher yield.

A major cause of reduced grain yield of millet was poor seed set. One form of sterility appears to be induced by temperatures below 56-58 F during the early boot stage of development. Low temperatures at this stage may interfere with the development of the pollen mother cells or early stages of meiosis, resulting in aborted pollen grains.

Planting Dates and Rates

The millet hybrids tested were planted within the first two weeks of June and reached half-bloom by August 15. Physiological maturity (maximum grain weight) occurred approximately 25-30 days after flowering.

The small seeds of millet caused problems in stand establishment when conventional surface planting equipment was used. These problems were increased in heavier soils where crusting can occur. A seeding rate of 50,000 seeds/acre (1 lb/acre) was used, with a 50% rate of establishment observed. Planting depths were the same as for sorghum, 1-3 inches, depending upon soil texture and moisture depth.

Weed Control

Tolerance of pearl millet seedlings to propazine, terbutryn, or bifenox applications was excellent 10 days after treatment. Pearl millet seedlings also showed excellent tolerance to atrazine when grown in heavier soils, but atrazine could not be used on sandy soils. Emergence of pearl millet was severely reduced by propachlor or butylate plus R-25788 applications and was prevented by propachlor applications in combination with other herbicides or EPTC plus R-25788 ap-

Table 2. Rolled millet compared to rolled sorghum for finishing steers, March 22 to July 13, 1984 (114 days).

Item	Treatment	
	Sorghum	Millet
Number of head	34.00	16.00
Initial weight, lb.	739.40	732.80
Final weight, lb.	1057.70	1064.00
Total gain, lb.	318.30	331.20
Average daily gain, lb.	2.79	2.90
Carcass data:		
Dressing percent	63.90	64.70
Backfat, in.	.53	.60
Energy density, C/g	4.27	4.34
Energy gain, Mcal/day	6.84	7.18
Marbling score	4.74	4.66
Percent choice	79.00	67.00
Percent liver abscesses	20.00	56.00
Average feed intake lbs.:		
Sorghum silage	12.57	12.23
Grain	19.30	19.30
Soybean meal	.49	.27
Urea	.08	.03
Bovatex premix*	.55	.55
Total dry matter	20.42	20.15
Lb. gain/100 lb. feed	13.20	13.95
Gain net energy, Mcal/kg		
NE (m)	2.10	2.22
NE (g)	1.39	1.45

* Premix includes 300mg Bovatec, 50g ammonium sulfate, 100g limestone, Vitamin A, 1g niacin and trace minerals.

Table 3. Rolled millet compared to rolled sorghum in high silage growing rations.

Item	Treatment			
	Control		Rumensin*	
	Sorghum	Millet	Sorghum	Millet
Number of cattle	30.00	29.00	30.00	30.00
Average initial wt. lb.	507.00	509.40	506.90	506.40
Average final wt. lb.	805.30	799.70	793.10	820.90
Average gain, lb.	298.30	290.30	286.20	314.50
Average daily gain, lb.	2.46	2.40	2.36	2.60
Average daily ration, lb.				
Sorghum silage	41.78	39.65	39.31	38.58
Rolled milo	4.00	——	3.99	——
Rolled millet	——	4.66	——	4.66
Soybean meal	1.25	.58	1.25	.58
Premix	.31	.31	.41	.41
Air-dry total	19.52	18.89	18.79	18.62
Lb. feed/100 lb. gain	811.00	791.00	803.00	743.00

* No endorsement is intended, nor is any criticism implied of similar product not mentioned.

plications. In the yeld trials, propazine gave good control of most annual broad-leaf weeds and fair to poor control of annual grasses.

Pearl Millet for Livestock Feed

Nearly all of the world's crop of pearl millet grain is consumed as food for humans and very little information is available concerning its use in livestock rations. When compared to sorghum grain, pearl millet grain has higher levels of both fat and protein, and the protein has a better balance of amino acids. Preliminary studies at Fort Hays showed that steers fed millet gained as well as those fed sorghum (Table 2). Estimated net energy of millet was 4 percent higher than that of finely rolled sorghum. Pearl millet is an excellent source of protein for beef cattle rations. In other trials, steers were fed enough millet (16% crude protein) to permit omitting soybean meal and urea from the ration. Millet grain, when used with Rumensin in growing rations for calves (Table 3), gave significantly higher daily gains than sorghum.

Conclusions

Pearl millet has the potential of being an alternate crop in the semi-arid, grain producing areas. Evaluations have shown yields as high as 4800 lbs./acre and top yields averaging approximately 80% of sorghum yields. Weed control can be obtained through cultivation and applications of propazine, terbutryn or bifenox. Furthermore, pearl millet is an excellent protein source and growing ration for livestock.

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