PROGRESS REPORT

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MILLET PRODUCTION WITH LIMITED WATER

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INTRODUCTION

The millets, proso and foxtail, are among the best adapted crops for the cool semiarid climate of northeastern Colorado and western Nebraska. Unfortunately, millet too often has been planted as a last minute afterthought and not as a designed crop. In this case, millet acts as a catch crop when wheat fails or fills in acreage adjustments under allotment programs for wheat. Millet yields often are restricted by lack of water conservation in advance of planting, poor weed control, and inadequate and poorly timed seeding systems.

METHODS

Recent experiments at the Akron station (1973-1977) suggest that millet yields can be surprisingly high with limited water under certain conditions of planned management. The titles of these experiments are listed below:

Exp. 1 Yield and water use efficiency of proso millet under three dryland crop rotations: continuous millet, fallow-wheat-millet, and fallow-millet.

Exp. 2 Fall weed control in wheat stubble as preparation for cropping with proso millet.

Exp. 3 Pre-emergence herbicides for weed control during the growing season of millet.

The years 1972-1977 averaged only 14.31 annual precipitation or about two inches below normal. Snowfall was above normal but growing season rainfall was much below normal four of the five test years. The storage of soil water involves the time lag from crop to crop and the effectiveness of precipitation during those time lags. For continuous millet at Akron the dormant season is from late August to early June (9½ months); for millet after wheat from early July to early June (11 months) and for millet after fallow 21½ months.

Results Exp. 1 (see Tables 1, 2 and Fig. 1)

The yield of proso millet was directly related to the amount of stored soil water at the preplant stage. The base point for grain production of millet began at about 5.5 inches water consumption which is 3 to 3½ inches less than required for winter wheat. Total water required to produce 18 to 20 bu/acre was only 10 inches and it took very little extra water to increase yields to 30 and 40 bu/acre. Water use efficiency was also increased rapidly.

In general, continuous millet at Akron was a marginal proposition unless dormant season precipitation was above average and crop season rainfall average or above. Millet after fallow assures good stored soil water but involves only one crop every two years, thus on an annual basis yielded no better than continuous millet.

The best overall production was achieved in the fallow-wheat-millet rotation where a yield of 27.3 bu/acre was obtained compared with 19.2 bu/acre for continuous millet. In this case the extra 1½ month time lag succeeding wheat added another 1.08 inches more stored soil water. This in turn produced an extra 8.1 bu/acre yield.

In terms of varieties tested (Table 2) Leonard was equal to Common White and Turghai under fallow but averaged 7.3 bu/acre less under continuous cropping and 6.4 bu/acre less succeeding wheat. Leonard is a taller, leafier, later maturing variety with a higher straw-grain ratio than Common White and Turghai. Under good water Leonard showed a much higher dry matter yield potential than the other two.

Results Exp. 2 (See Table 3)

This experiment showed that by reducing the weed growth in wheat stubble by fall sweep and/or herbicides, more water and soil nitrates would be available for the succeeding millet crop. These extra growth inputs for the years tested, although moderate in amount at .68 inches water and 15 lb/acre of nitrogen, were sufficient to increase the yield of millet by an average 5 bu/acre. Fall sweep + atrazine at 1 lb/acre proved the best treatment tested. Not attempted, but certainly a good bet, would be a combination of contact herbicide (⅛ lb. paraquat + ⅛ lb. 2,4-D + ½ lb. atrazine/acre).

Results Exp. 3 (see Table 4)

Pigweeds have been the leading weed contaminant in growing millet at Akron. Attempts to control pigweed and other broadleafs with low rates of 2,4-D usually failed. Therefore a series of pre-emergence herbicides were attempted including Igran, Bladex, Sencor, Milogard, and atrazine. Milogard and atrazine were by far the most successful of the herbicides tested and with rates as low as ¼ and ½ lb/acre applied with 15 gallons/acre water three to four weeks before planting.

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Millet yields were increased an average 8 and 6 bu/acre for atrazine and milogard at ½ lb/acre rates respectively during a three year test. Plots remained 100 percent weed free from planting to harvest with no evidence of damage to millet. The general results suggest that applications of ⅓ lb/acre is sufficient for either herbicide as a pre-emergence treatment for millet. Check with the EPA for labeling of use.

RESULTS

Proso millet is a low water requirement short-season (60-70 days) crop well adapted to cool semiarid conditions of the United States. Total water use of 13 inches will produce 40 to 50 B/A assuming weed-free growing conditions. Hay millet (80-90 days) requires about two to three inches more water per season than proso millet for high yields.

Proso millet has a much lower straw-grain ratio than wheat, barley, oats, or sorghum. The protein content is equal to wheat.

Irrigated millet or continuous dryland millet can be made weed free with rates of ⅓ to ½ lb/acre active atrazine or milogard surface applied 20 to 30 days in advance of planting. Planting dates vary from late May to mid-June. There is a tendency for late June - early July planted proso millet to grow short in height, because it is sensitive to decreasing sunlight hours in August.

Millet is readily adaptable to fallow-wheat-millet rotations. Weeds in new wheat stubble should be controlled, and wheat stubble should remain upright to catch snow. Weed control by fall undercut with big sweeps 4" deep and/or use atrazine or milogard at 1 to 1¼ lb/A active.

Dryland millet on good soils shows little response to nitrogen unless previous crop residues are heavy and available water is above average. Rates of 25 lb/acre nitrogen for irrigated proso millet and 40 lb/acre nitrogen for irrigated hay millet is recommended. In all cases, apply nitrogen 20 to 30 days before seeding.

With weed free millet, seeding rates should be reduced and row width widened to 12 inches. Consider direct combine harvest if crop is taller than average and seed appears to be uniformly dry; otherwise, the swath and dry pickup harvest system is recommended.

Recent Literature

Hinze, Greg. 1977. Millets in Colorado. Colorado State University Experiment Station Bull. 553S.

Greb, B. W. 1978. Millet production with limited water. U.S. Central Great Plains Research Station, Miscl. Handout.

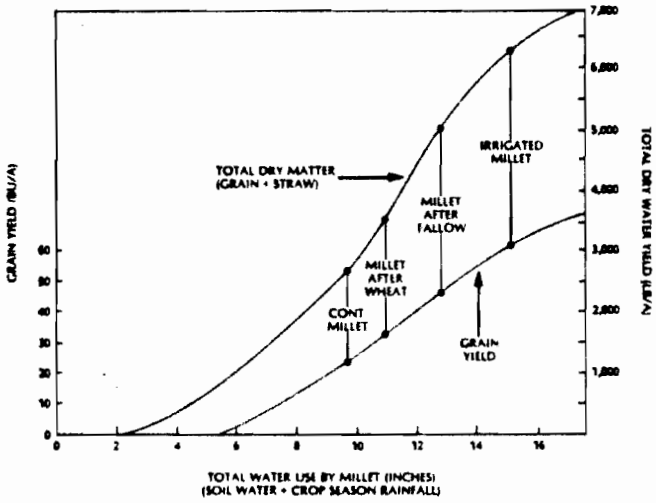

Figure 1. General range of proso millet yield expectancy, NE Colorado. (Assuming weed-free millet).

Table 1. Five-year average (1973-1977) of growth inputs and yield of proso millet under three dryland crop rotations. Soil sampling to 6-ft. soil depth for soil water and 3-ft. depth for available soil nitrate nitrogen. Nonfertilized millet, Akron, CO.

	Growth Inputs				
Millet Rotations	Avail. Nitrogen	Soil Water At Preplant	Soil Water At Harvest	Soil Water Use	Total Water Use[a]
	LB/A	Inches Avail.			
Continuous Millet	77	5.88	1.92	3.96	10.00
Millet after Wheat	68	6.96	2.17	4.79	10.83
Millet after Fallow	166	8.03	2.29	5.74	11.78

[a]Soil water use plus 6.04 inches crop season rainfall.

	Yield Output				
Millet Rotations	Grain Yield	Straw Yield	Total Dry Matter	Water Use Eff.[a]	Protein Grain
	B/A	Lb/A	Lb/A	Lb/A/In.	%
Continuous Millet	19.2	1,505	2,580	260	12.2
Millet after Wheat	27.3	1,960	3,490	320	11.9
Millet after Fallow	40.0	2,895	4,635	395	12.5

[a]Total dry matter ÷ total water use.

Table 2. Three-year performance average (1973-1975) of three nonfertilized millet varieties grown under dryland conditions.[a] Akron, CO.

Millet Varieties	Total Water Use[b]	Grain Yield	Straw Yield	Total Dry Matter	Straw - Grain	Water Use Eff.[c]	Protein Grain
	Inches	B/A	Lb/A	Lb/A	Ratio	Lb/A/In.	%
Common White	11.86	35.1	1,980	3,950	1.0	335	11.7
Turghai	11.67	32.6	2,065	3,890	1.1	335	12.4
Leonard	12.58	28.5	3,240	4,840	2.0	385	11.8

[a] Avg. of three rotations.

[b] Soil water use plus crop season rainfall.

[c] Total dry matter ÷ total water use.

Table 3. Five-year average (1973-1977), yield of proso millet as influenced by fall weed control in wheat stubble in a fallow-wheat-millet rotation.

Wheat Stubble Treatments	Fall Weed Growth	Soil Nitrates at Seeding	Total Water Use[a]	Millet Yield			Water Use Eff.[b]	Protein Grain
				Grain	Straw	TDM		
	Lb/A	Lb/A	Inches	B/A	Lb/A	Lb/A	Lb/A/In.	%
Spring Disk (check)	1,050	52	10.63	31.7	2,155	3,930	370	10.1
Double Fall Sweep	450	75	11.38	36.0	2,450	4,465	390	11.2
FS + Var. Herbicides[c]	500	60	11.17	35.3	2,435	4,410	395	10.5
FS + Atrazine 1.0 lb/A	350	68	11.39	38.4	2,660	4,810	420	11.2
Avg. All Treatments		64	11.14	35.3	2,425	4,405	395	10.7

[a] = Soil water use + avg. 6.38 inches crop season rainfall.

[b] = Total dry matter ÷ total water use.

[c] = Butyl Ester 2 lb/A, Igran 1.0 lb/A, Atrazine ½ lb/A.

Table 4. Proso millet (Common White) yields resulting from use of pre-emergence herbicides, Akron, CO. Summary, three year test.

Millet Rotations	Year	Check		Atrazine ½ lb/A		Milogard ½ lb/A	
		Grain	Straw	Grain	Straw	Grain	Straw
		B/A	Lb/A	B/A	Lb/A	B/A	Lb/A
Fallow-Millet	1974	27.0	1,550	38.8	1,900	37.5	2,000
Cont. Millet	1975	33.1	2,095	42.3	2,440	42.2	2,365
Cont. Millet	1976	24.5	2,095	30.2	2,550	27.8	2,400
Avg.		28.2	1,915	37.1	2,295	35.1	2,255