STUBBLE MULCH FALLOW AND DATES OF PRIMARY SWEEP TILLAGE ON SOIL WATER STORAGE

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PROGRESS REPORT

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The virtues of stubble mulch tillage have been a controbersial subject for a number of years. Although straw mulches were known to effectively reduce wind and water erosion potential, the effect of these mulches on soil water storage, temperatures, nitrate accumulation, and crop yields was much less known. In the early 1960's, major stubble mulch field experiments were initiated at Sidney, Montana (A. L. Black), North Platte, Nebraska, (D. E. Smika), and Akron, Colorado (B. W. Greb) with each of these experiments having similar objectives, procedures, and field installations. Experimental details, results and conclusions of these three experiments can be obtained from the attached list of literature references.

PROCEDURE

The major aspects of the experiment are itemized in Table 1. The fallow period was 14 months long, beginning in mid-July. Straw yields were determined following harvest and the designated application rates of straw mulch were established by removing excess straw or adding new straw. By mid-May, normal overwinter losses plus the effect of tillage generally reduced the straw to about 60% of the original mulch. The soil (Weld silt loam) holds a maximum of 12 to 14 inches of available water to a 6-foot depth, but such quantities were only approached during the 1967 season.

RESULTS (See Table 2)

1. Soil water storage during fallow was increased by 0.7 and 1.6 inches by the use of 3000 and 6000 lbs/acre straw mulch compared with 1500 lbs/acre. Fallow efficiencies of 28, 31, and 35% were recorded for the 1500, 3000, and 6000 lbs/acre mulch, respectively.
2. A single fall blading increased water storage by an average 0.65 inch compared with spring blading during the first five years of testing. However, with a sixth year (data not included), fall blading has exceeded spring blading in storing water in fallow by an average 1.0 inch for the last four seasons attempted. Twice in six years, the better gains of water by eliminating fall weeds were lost by the increased consumption of water by volunteer wheat.
3. Within the fallow season, the best water efficiencies occurred during the winter season at 41% and the lowest during the summer at 10%. The greatest net gains of soil water occurred during the late spring when the heaviest rainfall was received.
4. Soil nitrate accumulation during fallow averaged 122, 118, and 104 lbs/acre mulch and 124, 116, and 105 lbs/acre by the use of fall, early spring, and mid-spring primary subtillage in that order.
5. Yield of grain was increased 175 lbs/acre per year (3-year ave.) and straw 345 lbs/acre per year (4-year ave.) by use of 6000 lbs/acre mulch compared with 1500 lbs/acre mulch. This increase was related to better stored soil water with the higher rate of mulch during fallow.
6. Total dry matter production of wheat averaged 4495, 4170, and 4180 lbs/acre with fall, early spring, and mid-spring fallow in that order.
7. Protein content of wheat averaged 14.0, 14.1, and 14.1% with fall, early spring, and mid-spring fallow respectively; and 14.4, 14.3, and 13.5% for the 1500, 3000, and 6000 lbs/acre rates of mulch.
8. Although grain and straw responded to N-fertilization to some degree in two of three years tested, the yield response was not economical.

Recent Stubble Mulch Publications:

1. Black, A. L. and J. F. Powers. 1965. Effect of chemical and mechanical fallow methods on moisture storage, wheat yields and soil

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erodibility. Soil Sci. Soc. Am. Proc. 29: 465-468.
2. Black, A. L., and B. W. Greb. 1968. Soil reflectance, temperature and fallow water storage on exposed subsoils of a Brown soil. Soil Sci. Soc. Am. Proc. 32: 105-109.
3. Greb, B. W. 1966. Effect of surface-applied wheat straw on soil water losses by solar distillation. Soil Sci. Soc. Am. Proc. 30: 786-788.
4. Greb, B. W., D. E. Smika, and A. L. Black. 1967. Effect of straw mulch rates on soil water storage during summer fallow in the Great Plains. Soil Sci. Soc. Am. Proc. 31: 556-559.
5. Greb, B. W. 1967. Percent soil cover by six vegetative mulches. Agron. J. 59: 610-611.
6. Greb, B. W., D. E. Smika, and A. L. Black. 1970. Water conservation with stubble mulch fallow. J. Soil and Water Cons. 25: 58-62.
7. Smika, D. E. and C. J. Whitfield. 1966. Effect of standing wheat stubble on storage of water precipitation. J. Soil and Water Cons. 21: 138-141.
8. Smika, D. E. and G. A. Wicks. 1968. Soil water storage during fallow in the Central Great Plains as influenced by tillage and herbicide treatments. Soil Sci. Soc. Am. Proc. 32: 591-595.
9. Smika, D. E. 1969. Summer fallow for wheat production in the Great Plains. Agron. J. 62: 15-17.
10. Smika, D. E., A. L. Black, and B. W. Greb. 1969. Soil nitrate, soil water, and grain yields in a wheat-fallow rotation in the Great Plains as influenced by straw mulch. Agron. J. 61: 785-787.

Table 1 - Description of Field Plot Procedures for Stubble Mulch Fallow Experiment.

Experimental Procedure	Measurement Unit	Akron, Colorado
Length of experiment	years	5
Soil type		Weld silt loam
Slope of plot area	percent	0.5
Experimental variables		Rates of straw X dates[c] subtillage
Rates of straw	pounds/acre	1500, 3000, 6000
Replications	number	3
Plot water control		Yes
Plot size	feet	36 X 100
Fallow tillage	number/year	4 to 6
Primary: sweep[a]	inches/blade	60
Secondary: variable		Miller Rod[b]
Soil water sampling		Gravimetric, oven-dry basis
Per plot	number	2
Times in year	number	5
Depth	feet	6

[a] Sweep V-shaped blades used at least twice if no burial of straw; 24-inch one-way disk for straw burial at North Platte.

[b] Rotating bar with tongs that lifts straw and clods over the bar.

[c] Fall, early spring, mid-spring.

Table 2 - Soil Water Storage, Fallow Efficiency, and Wheat Yields Resulting from Straw Mulches and Dates of Primary Tillage on Fallow.

Fallow Treatment	Avail. Water End Fallow[a]	Net Gain Avail. Water, Fallow[a]	Fallow Efficiency[ab]	Soil Nitrates End Fallow	Wheat Yields		
					Grain[c]	TDM[d]	Protein[c]
	Inches	Inches	%	Lbs/A	B/A	Lbs/A	%
Straw Mulches (Lbs/A)							
1500	7.4	6.1	28	124	22.8	3,990	14.0
3000	8.0	6.8	31	116	24.0	4,400	14.1
6000	9.2	7.7	35	105	25.7	4,510	14.1
Date Primary Sweep							
Fall (Aug. 5)	8.6	7.3	33	122	25.2	4,495	14.4
E. Spr. (Apr. 5)	7.9	6.5	30	118	23.6	4,170	14.3
Mid-Spr. (May 5)	8.1	6.8	31	104	23.7	4,180	13.5

a - Five year average (1963-1967)

b - Fallow efficiency = $\frac{\text{net gain soil water (in.) X 100}}{\text{Fallow pptn. (in.)}}$

c - Three year average, lost grain production in 1965 and 1966 to hail storms.

d - Four year average, lost total dry matter yield (TDM) in 1965 to hail storm.