THE EFFECT OF SOIL FERTILITY ON THE EFFICIENCY OF WATER USAGE BY PLANTS*

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No attempt is made here to review the widely published literature on this subject. Investigators recognize the importance of the moisture-fertility balance in soils in making recommendations for cropping systems and fertilizer practices.

In 1892 an acre of land in virgin sod was set aside by the Oklahoma Agricultural Experiment Station for the study of soil fertility and wheat production. This land was seeded on November 22, 1892, to Red Fultz wheat and harvested June 19, 1893. The yield was 10.55 bushels per acre. Wheat has been the only crop grown on the land and there is a continuous record of 48 wheat crops produced since the land was brought under cultivation.

In the fall of 1898, one-half of this acre was manured at the rate of 15 tons of farm manure per acre, and has been regularly manured since then. No farm manure was applied to the rest of the area. The first year's results showed 30.6 bushels of wheat per acre on the manured area and 12 bushels per acre on the unmanured. A continuous comparison is on record for 42 years. This experiment was conducted with soils from these two plots. The differences between the present levels of fertility of the two plots are shown below:

Plot	Total nitrogen	Soluble phosphorus	Replaceable K	Acidity
	%		*p. p. m.*	*pH*
Manured	0.1068	Medium	199	5.1
Unmanured	0.0847	Low	111	4.9

Experiments on efficiency of utilization of moisture. In the fall of 1939, pots of soil from the two plots, each containing approximately 10 pounds, were placed in the greenhouse. A number of these pots were planted to Sudan grass October 9, and others were left unplanted. The moisture content of each pot (whether planted or unplanted) was raised to an optimum for growth and maintained at this level by weighing and adding

TABLE 1.

Plot Treatment	Ave. total loss of water from cropped soil	Ave. total loss of water from fallow	Water lost by transpiration	Weight oven-dry of tops	Transpiration ratio
	gms.	*gms.*	*gms.*	*gms.*	
	Results with Sudan grass, 1939				
Manured	4040	2892	1148	2.91	395
Unmanured	3436	3061	375	0.59	636
	Results with corn, 1940				
Manured	3371	1927	1414	6.010	235
Unmanured	3528	2291	1237	3.965	312

* A contribution from the Oklahoma Agricultural Experiment Station, Agronomy Department.

water from time to time. Usually the pots were brought to weight every other day. On December 11, 1939, the final weighings were made and the Sudan grass harvested. The fallowed pots were used as a check for evaporation. This experiment was repeated with corn during the period October 3 to December 3, 1940. The results are set forth in table I.

It is assumed that the amount of water lost by the fallowed soils represents evaporation losses and that these are identical for the cropped soils. This assumption is not exactly valid, but is thought to be sufficiently so to warrant the comparison. At least, the total moisture loss from the two cropped soils indicates the difference in efficiency in relation to the crop produced. In 1939, to produce a unit of dry Sudan grass from the manured and unmanured soils required 1388 and 5823 units of water, respectively, including both evaporation and transpiration losses. The corresponding figures for corn (1940) are 561 and 889. The loss of water in each case, of course, is higher than it would be under field conditions because of the presence of optimum moisture conditions at all times. Normally this would not be the case in the field; therefore the loss would be less. Higher temperatures prevailed during the experimental period in 1939 than during 1940.