

THE UTILIZATION OF FARM MANURE

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History reveals that shortly after the American Colonists became well established along the eastern coast they discovered that they must turn their attention to the preservation of the fertility of the lands from whence came their food supply. There are some records which show that even the American Indians, previous to the coming of the white man, used means of restoring fertility and increasing the productiveness of their corn fields. What was true of the original colonies, in this respect, has also been true of each successive settlement as the pioneers pushed their course westward across the continent. This civilization, as have civilizations in other parts of the world, established the fact that as lands are tilled and kept long under cultivation, they gradually lose their power of productiveness, and productiveness must be restored and maintained if the population thereon is to flourish and prosper.

Manure is usually the first material to be used in an effort to restore and maintain a productive soil. Lyman Carrier in his book, "Beginnings of Agriculture in America," cites incidents as early as 1630 where manure was used by colonists to increase the productiveness of their farm lands. In the same book is cited a record where a man by the name of Wm. Shipley of Wilmington, Delaware, in 1750 quoted on stable manure a price of 6½ cents for a single horse load, and 10 cents for a two horse load. King states (Farmers of Forty Centuries) that China is supporting a population of some 500,000,000 on an area smaller than the improved farm lands of the United States. The Chinese are cultivating and obtaining their food supply from lands which have probably been farmed for over forty centuries. The fertility of these lands has been maintained up until very recently, mainly by returning to the land a compost which is made up very largely of manure.

Lincoln in an address delivered at Milwaukee in 1859 apparently had in mind the preservation of fertility when he said, "For the last four years I do not believe the ground planted with corn in Illinois has produced an

average of twenty bushels. It is true that heretofore we have had better crops with no better cultivation; but I believe it is also true that the soil has never been pushed up to one-half its capacity." In the same speech he mentioned experiments with manure as one of the means by which may be grown better crops.

"The word manure is derived from the French 'manoeuvrer', to manipulate, to work, and in its earlier significance meant both tilling or working the land and adding to it materials designed to increase its productiveness. In America we sometimes speak of such crops as green manure, but with this exception, we limited the words manure and manuring to the excreta of animals and their use for soil enrichment." (Thorne Farm Manures, p. 81.) In the following discussion manure will mean the excreta of farm animals with straw or other material used for bedding, or as an absorbent.

Statements from various publications give some idea of the volume of manure produced and its probable value. Regarding the waste of manure in the United States, Director Thorne (Farm Manures, p. 150) makes the following statement: "It is a very conservative estimate to place the waste of this manure under prevalent systems of management at 25 percent, or \$50,000.00 annually. It is probably more nearly twice that amount." Professor Roberts (Ky. Sta. Circ. 164) states that farms in Kentucky produce 10,000,000 tons of manure annually, half of which is wasted, representing a probable loss of \$15,000,000. Professor Wiancko (Ind. Sta. Bul. 222) states that one-third of the manure made on Indiana farms each year is wasted by improper methods of conservation and handling, representing an annual loss of approximately \$26,000,000. The above stated sums, while in some degree representing paper losses, yet serve to show the immense potential value of farm manure when properly conserved and utilized on lands for food production.

In Illinois manure is a by-product of livestock farming, and its ultimate value depends upon its ability to increase productiveness when used for soil enrichment. Manure in this state does not have a definite market value, nor is

there in general use any fixed standards for computing its value. Chemical analysis might furnish a basis for a value, but the composition varies greatly and the chemical elements in manure do not have the same influence on crop yields when used on different soil types and with other variable conditions. The increased crop yields as a basis for manure valuation are subject to variation. The increased yield obtained will vary with the composition of the manure, the amount used, soil type, kind of crop grown, climate and other factors. The influence of these variations on value might be determined by observing results under these various conditions. Values based on actual production may be determined by resorting to experimental data obtained from various sections of this state, and also there is data available for almost every state in the Union and for states in different parts of the world. In early times manure, being about the only known fertilizing material, came to be generally used in early experiment station work. The scientific literature on manure and subjects relating to its use is voluminous. There seems to be no detail regarding its relation to agriculture that has not been investigated and thoroly reported.

In this state during the past twenty years manure has been used for soil enrichment in many field experiments. These experiments have been conducted on different soil types and with many variable conditions. In these field tests it has been the aim to utilize manure in much the same manner as it is used on the average farm. From a summary of these field results may be obtained a fairly accurate valuation of farm manure.

The Illinois manure experiments are based upon the idea that in a system of livestock farming manure may be applied to land at a rate corresponding to the rate of crop production. This plan allows one ton of manure for each ton of crops consumed. The Ohio Experiment Station shows that when livestock is fed on a cement floor under shelter, 1.3 to 1.5 tons of manure are produced for each ton of feed and bedding used. Illinois farm conditions as a rule do not allow such care in the preservation of manure; so it seems entirely possible that the average

farm loss would amount to one-fourth to one-third of the total under prevailing practice.

In the following tables and discussion there are presented results from twelve Illinois experiment fields located on large and important soil areas of the state. The Brown Silt Loam Prairie soil is the predominating type of the fertile corn belt of Central and Northern Illinois. The Gray Silt Loam Prairie soil is the prevailing type in South Central Illinois. The Yellow-Gray Silt Loam timber soil represents the more rolling lands of extreme Southern Illinois.

The tables are arranged to show the crop yields on manured and untreated land; also the increase in yields due to manure. Manure is applied for the corn crop in the rotation and at the rate of a ton of manure for each ton of crops removed. An amount sufficient to supply that rate for four years is put on at each application. The years represent the crop averaged and the length of time manure has been applied for each crop. The average ends with 1924.

Grain and hay values used as follows: Wheat, \$1.00; corn, 75 cents; oats, 40 cents; hay, \$15 per ton; seed cotton, 7 cents a pound. Manure values are based on these prices. No value is placed on straw and corn stover.

MT. MORRIS EXPERIMENT FIELD—(Ogle County.)

Brown Silt Loam, Prairie Soil.

Manure applied at average annual acre rate 2.61 tons.

	Wheat 10 Yrs.	Corn 13 Yrs.	Oats 12 Yrs.	Clover 11 Yrs.
Land manured	27.6 bu.	58.1 bu.	69.1 bu.	5,000 lbs.
Land untreated	23.1 bu.	43.8 bu.	59.4 bu.	4,080 lbs.
Increase for manure	4.5 bu.	14.3 bu.	9.7 bu.	920 lbs.

Manure value per acre, \$6.67
Manure value per ton, 2.55

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DIXON EXPERIMENT FIELD (Lee County)

Brown Silt Loam, Prairie Soil.

Manure applied at average annual rate 2.43 tons.

	Wheat 9 Yrs.	Corn 13 Yrs.	Oats 12 Yrs.	Hay 11 Yrs.
Land manured	25.4 bu.	53.0 bu.	63.4 bu.	4,520 lbs.
Land untreated	19.4 bu.	34.2 bu.	51.6 bu.	3,320 lbs.
Increase for manure	6.0 bu.	18.8 bu.	11.8 bu.	1,200 lbs.

Manure value per acre, \$9.28

Manure Value per ton, 3.78

LA MOILLE EXPERIMENT FIELD (Bureau County)

Brown Silt Loam, Prairie Soil.

Manure applied at average annual rate of 3.23 tons per acre.

	Wheat 10 Yrs.	Corn 13 Yrs.	Oats 12 Yrs.	Clover 9 Yrs.
Land manured	39.0 bu.	57.2 bu.	72.2 bu.	5,880 lbs.
Land untreated	31.2 bu.	50.5 bu.	65.1 bu.	5,300 lbs.
Increase for manure	7.8 bu.	6.7 bu.	7.1 bu.	580 lbs.

Manure value per acre, \$4.94

Manure value per ton, 1.53

URBANA DAVENPORT PLOTS (Champaign County)

Brown Silt Loam, Prairie Soil.

Manure at average annual acre rate 2.59 tons.

	Wheat 14 Yrs.	Corn 14 Yrs.	Oats 14 Yrs.	Clover 14 Yrs.	Alfalfa 12 Yrs.
Land manured	29.8 bu.	64.4 bu.	62.6 bu.	4060 lbs.	5420 lbs.
Land untreated	26.6 bu.	53.1 bu.	52.7 bu.	3560 lbs.	5280 lbs.
Increase for manure	3.2 bu.	11.3 bu.	9.9 bu.	500 lbs.	140 lbs.

Manure value per acre, \$4.10

Manure value per ton, 1.58

CARTHAGE EXPERIMENT FIELD (Hancock County)

Brown Silt Loam, Prairie Soil.

Manure applied at average annual rate of 1.83 tons per acre.

	Wheat 10 Yrs.	Corn 13 Yrs.	Oats 12 Yrs.	Clover 11 Yrs.
Land manured	24.4 bu.	40.5 bu.	39.3 bu.	4,500 lbs.
Land untreated	20.3 bu.	33.6 bu.	34.0 bu.	4,280 lbs.
Increase for manure	4.1 bu.	6.9 bu.	5.3 bu.	220 lbs.

Manure value per acre, \$2.96

Manure value per ton 1.62

CLAYTON EXPERIMENT FIELD (Adams County)

Brown Silt Loam, Prairie Soil.

Manure applied at average annual rate of 1.99 tons per acre.

	Wheat 10 Yrs.	Corn 13 Yrs.	Oats 12 Yrs.	Clover 11 Yrs.
Land manured	21.5 bu.	48.2 bu.	44.1 bu.	4,680 lbs.
Land untreated	16.8 bu.	31.3 bu.	36.1 bu.	3,960 lbs.
Increase for manure	4.7 bu.	16.9 bu.	8.0 bu.	720 lbs.

Manure value per acre, \$6.71

Manure value per ton, 3.37

EWING EXPERIMENT FIELD (Franklin County)

Gray Silt Loam on Tight Clay, Prairie Soil.

Manure applied at average annual rate of 0.86 tons per acre.

	Wheat 9 Yrs.	Corn 14 Yrs.	Oats 13 Yrs.	Hay 12 Yrs.
Land manured	3.4 bu.	22.8 bu.	15.0 bu.	480 lbs.
Land untreated	1.9 bu.	11.2 bu.	10.2 bu.	380 lbs.
Increase for manure	1.5 bu.	11.6 bu.	4.8 bu.	100 lbs.

Manure value per acre, \$3.50

Manure value per ton, 4.06

TOLEDO EXPERIMENT FIELD (Cumberland County.)

Gray Silt Loam on Tight Clay, Prairie Soil.

Manure applied at the average annual rate of .87 tons per acre.

	Wheat 7 Yrs.	Corn 12 Yrs.	Oats 10 Yrs.	Hay 9 Yrs.
Land manured	10.0 bu.	25.7 bu.	21.1 bu.	800 lbs.
Land untreated	8.6 bu.	20.4 bu.	17.7 bu.	580 lbs.
Increase for manure	1.4 bu.	5.3 bu.	3.4 bu.	220 lbs.

Manure value per acre, \$2.05

Manure value per ton, 2.35

OBLONG EXPERIMENT FIELD (Crawford County)

Gray Silt Loam on Tight Clay, Prairie Soil.

Manure applied at the average annual rate of 1.05 tons per acre.

	Wheat 11 Yrs.	Corn 12 Yrs.	Oats 10 Yrs.	Hay 9 Yrs.
Land manured	11.2 bu.	28.7 bu.	23.0 bu.	1,260 lbs.
Land untreated	8.8 bu.	20.1 bu.	16.4 bu.	820 lbs.
Increase for manure	2.4 bu.	8.6 bu.	6.6 bu.	440 lbs.

Manure value per acre, \$3.83

Manure value per ton, 3.64

RALEIGH EXPERIMENT FIELD (Saline County.)

Yellow-Gray Silt Loam, Timber Soil.

Manure applied at average annual rate of 1.11 tons per acre.

	Wheat 9 Yrs.	Corn 14 Yrs.	Oats 13 Yrs.	Clover 12 Yrs.
Land manured	7.6 bu.	28.1 bu.	13.1 bu.	1,080 lbs.
Land untreated	5.7 bu.	14.7 bu.	10.0 bu.	800 lbs.
Increase for manure	1.9 bu.	13.4 bu.	3.1 bu.	280 lbs.

Manure value per acre, \$4.14

Manure value per ton, 3.73

ENFIELD EXPERIMENT FIELD (White County.)

Yellow-Gray Silt Loam, Timber Soil.

Manure applied at average annual rate of .93 tons per acre.

	Wheat 8 Yrs.	Corn 11 Yrs.	Oats 11 Yrs.	Hay 10 Yrs.
Land manured	5.4 bu.	27.9 bu.	15.0 bu.	560 lbs.
Land untreated	4.4 bu.	18.8 bu.	11.7 bu.	460 lbs.
Increase for manure	1.0 bu.	9.1 bu.	3.3 bu.	100 lbs.

Manure value per acre, \$2.33

Manure value per ton, 2.50

UNIONVILLE EXPERIMENT FIELD (Massac County.)

Yellow-Gray Silt Loam, Timber Soil.

Manure applied at average annual rate of 1.17 tons per acre.

	Cotton 9 Yrs.	Wheat 10 Yrs.	Corn 12 Yrs.	Hay 11 Yrs.
Land manured	328 lbs.	8.5 bu.	24.0 bu.	1,520 lbs.
Land untreated	192 lbs.	4.2 bu.	19.0 bu.	1,280 lbs.
Increase for manure	136 lbs.	4.3 bu.	5.0 bu.	240 lbs.

Manure value per acre, \$4.61

Manure value per ton, 3.93

The crop yields and values in these tables do not take into consideration the residual manure remaining in these soils. It is evident that if these soils were cropped until the manure was entirely extracted the value per ton of manure would be considerably increased. This is substantiated by some evidence from the Woburn (England) Experiment Station. In this experiment 40 tons of manure were applied during a five year period, and the land cropped for thirty years. The first ten years (1877-86) this manure value based on crop yields was \$1.29 per ton. For the twenty year period (1877-96) the ton value was \$2.93. The thirty year period (1877-1906) the ton value was \$3.83. This test shows the possibility of the residual value of manure. (Jour. Roy. Agr. Soc. Eng. V. 39 to 67.)

The following table summarizes the average tons per acre applied annually on the soil types indicated, and the

acre and ton value of manure based on production. Each section of the state is represented by three experiment fields.

	Tons Applied	Acre Value	Ton Value
Brown Silt Loam Northern Illinois.....	2.76	\$ 6.96	\$ 2.62
Brown Silt Loam Central Illinois.....	2.14	4.44	2.19
Gray Silt Loam South Central Illinois.....	.93	3.13	3.38
Yellow-Gray Silt Loam Extreme Southern Illinois	1.10	3.56	3.39

The above table and summary indicate that on an average Illinois corn belt land manure as a by-product is of sufficient value to warrant considerable care in its use and preservation. The amount which may be returned to these lands is such as to make it a very important factor in maintaining soil fertility.

The results show on the lighter soils of Southern Illinois that manure is very valuable. However, the present production of these soils is so limited that there is little prospect of maintaining and building up fertility by the use of manure alone.

Investigations show as a fertilizer, although ancient and long used, manure is still accepted and generally sought after for soil improvement. Its use does materially increase food production on Illinois soils. Its money value when measured by crop yields is such as to make it a valuable by-product of livestock farming. These values are such that farm equipment necessary for a more careful conservation of manure would likely be profitable.

The conservation of soil fertility and the production of an adequate food supply are very closely identified. At the present stage of our civilization there is a greater possibility of increasing the amount of food material produced per acre than there is of increasing the acreage suitable for production. With the tendencies of population to increase and concentrate in towns and cities, along with other social and economic tendencies, there is considerable prospect for a possible food shortage sometime in the future. Efforts to create more productive soils will render the food shortage less acute if that state of affairs ever arrives.