TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE Oregon SOIL CONSERVATION SERVICE

AGRONOMY - Technical Note No. 25 January 1973

The following technical note was prepared for use in California and is well suited for Oregon use.

A METHOD OF ESTIMATING LIVESTOCK MANURE APPLICATION RATES TO SOILS BASED ON PHOSPHORUS FERTILIZER VALUE

The following material is not intended to signify the amount of manure that can be safely applied to agricultural land. It will be of value only in cases where sufficient land is available to balance manure applications against crop needs for phosphorus. When there is sufficient land in a livestock enterprise to spread the manure produced according to crop phosphorus needs, the following material should be helpful in setting up sound utilization systems for the manure that is, or will be, available. There are no current research findings indicating that rates suggested by the following material cannot be safely exceeded.

Attempts to estimate the amount of manure needed to satisfy nitrogen needs of a crop are hazardous because the nitrogen content of manure decreases rapidly during initial stages of decomposition and nitrogen continues to be lost even after manure is applied to a field. Accurate application of nitrogen to crops can be made only by applying stable nitrogenous materials of known nitrogen content.

Unlike nitrogen, phosphorus evacuated in manure is stable and will remain in the manure throughout decomposition. Because phosphorus is not lost from manure, the number of days output of manure from various livestock required to meet a crops need for phosphorus can be estimated with fair accuracy. This assumes that the manure is stored in a manner to prevent significant loss of nutrients by leaching or storm runoff.

Manure from a given type of livestock will change in weight with age because of decomposition of its organic matter. Also, weight will vary with differences in moisture content under different methods of handling manure. Because of these variations, estimates of phosphorus evacuated by an animal are best made in "animal days," one animal day being the average amount of phosphorus an animal will excrete in manure in 24 hours. Using this system, a dairy cow spending 12 hours on pasture and 12 hours in the barns and lots daily would contribute only one-half animal day of manure to the storage facility.

The following tables are designed to provide information needed for estimating amounts of phosphorus in manure by animal days.

Table 1. Approximate Phosphorus Contents of Manure from One Animal*

Animal	Pounds Phosphorus Excreted Per Day		Per Year	
	As P	As P_2O_5	As P	As P_2O_5
1,200 pound dairy cow	0.05	0.11	18	41
1,000 pound feedlot steer	0.08	0.18	30	69
100 pound sheep	0.01	0.02	4	92
100 pound swine	0.02	0.05	7	16
4 pound poultry	0.003	0.007	1	2
1,000 pound horse	0.05	0.11	18	41
100 pound person	0.03	0.07	11	25

Table 2. Animal Days Manure Needed to Supply:

	Dairy	Steer	Sheep	Swine	Poultry	Horse
20 pounds P_2O_5 (9 pounds P) per ac.	180	110	1,000	400	2,800	180
30 pounds P_2O_5 (13 pounds P) per ac.	270	165	1,500	600	4,200	270
40 pounds P_2O_5 (18 pounds P) per ac.	360	220	2,000	800	5,600	360
50 pounds P_2O_5 (22 pounds P) per ac.	450	275	2,500	1,000	7,000	450
60 pounds P_2O_5 (26 pounds P) per ac.	540	330	3,000	1,200	8,400	540
80 pounds P_2O_5 (35 pounds P) per ac.	720	440	4,000	1,600	11,200	720
100 pounds P_2O_5 (44 pounds P) per ac.	900	550	5,000	2,000	14,000	900
200 pounds P_2O_5 (88 pounds P) per ac.	1,800	1100	10,000	4,000	28,000	1,800

*Individual analysis of total phosphorus show departures exceeding 25 percent of some values shown.

Sample Problems Illustrating Use of Table 2.

1. A dairyman wants to apply manure from his 600 cow dairy holding pond to land being used for corn. Approximately half of manure from herd goes into holding pond daily. Holding increment is 20 days. Soil test recommendation 50 pounds P_2O_5 per acre on corn land.

   To how many acres should one 20 day holding increment be applied?

   1/2 waste from 600 cows = 300 cows

   300 cows x 20 days = 6,000 animal days manure in pond

   From Table 2. - 450 animal days required to furnish 50 pounds P_2O_5 per acre.

   6,000 ÷ 450 = 13 acres

   How many acres would be fertilized per year?

   365 days per year ÷ 20 day holding interval = 18 holding intervals

   18 intervals x 13 acres per interval = 234 acres

   Cows per acre ratio 300/234 = 1.3:1

2. A local feeder wishes to apply the manure from 1,000 steers on feed to land to be seeded to irrigated grass and alfalfa. The extension agent recommends 100 pounds P_2O_5 prior to seeding. The manure is spread daily.

   How many acres should be covered daily to provide 100 pounds P_2O_5 per acre?

   1,000 steers x 1 day interval = 1,000 steer days manure to be spread daily.

   From Table 2. - 100 pounds P_2O_5 requires 550 steer days manure.

   1,000 ÷ 550 = 1.8 acres per day

   How many acres would be covered per year?

   365 x 1.8 = 660

   What is steers per acre ratio?

   1,000 ÷ 600 = 1.5:1

3. An egg producer with a 60,000 hen unit wishes to apply the poultry manure to land on which he hopes to produce 100 bushels per acre irrigated feed wheat. Soil analysis shows a very low level of available P. Wheat contains about 0.5 pounds P_2O_5 equivalent per bushel.

   How much chicken manure should be used to satisfy the crop need for P assuming 50 percent recovery?

   Assuming 50 percent recovery, one pound P_2O_5 per bushel or 100 pounds per acre will be needed.

   From Table 2. - 14,000 hen days manure will be needed per acre.

   How many acres should be covered by one day's manure from flock?

   60,000 ÷ 14,000 = 4.3 acres

   How many acres from one year's manure production?

   4.3 acres x 365 days = 1,560 acres

   What is the hens per acre ratio?

   60,000 hens ÷ 1,560 acres = 38:1

In reviewing the problems and tables on the preceding pages, note that one could apply 300 pounds P_2O_5 per acre as cow or steer manure without exceeding the currently accepted 5 animal per acre maximum stocking rate used to minimize adverse environmental effects. Three hundred pounds P_2O_5 per acre per year could be required to produce 14 tons alfalfa on soils low in available phosphate, assuming 50 percent recovery of applied phosphorus. It becomes evident, however, that manure from even three cows will usually exceed phosphate needs of an acre of irrigated crops.

In areas where crops respond to phosphorus fertilizers, College of Agriculture Extension Service recommendations for applying phosphorus may be followed in determining how much phosphorus to apply as animal manure. In areas where soils contain enough phosphorus that crops are not responding to phosphorus fertilizers, manure could be applied in the amounts needed to maintain soil phosphate reserves. This is done by applying sufficient manure to soil to replace phosphorus being removed in crops. Morrison's "Feeds and Feeding" and other references on animal nutrition contain tables showing mineral nutrient content of most feed crops. These tables are reliable guides for estimating soil phosphorus being used by various crops.

When the phosphorus need of crops is used as a guide to manure application on irrigated land, non-legume crops that are heavy users of nitrogen will usually require nitrogen in excess of that supplied by the manure. To

retain maximum nitrogen value, manure should be spread frequently (daily, if feasible), either diluted with irrigation water or with irrigation water applied immediately after spreading to minimize loss of ammonia to volatilization. This is very important because most of the nitrogen in fresh manure is in ammonia form. Much of the ammonia escapes even with careful management.