FACT SHEET

L-1220

FERTILIZATION OF CROPS WITH FEEDLOT WASTES ON THE TEXAS HIGH PLAINS

James H. Valentine, James R. Supak and Frank C. Petr*

Rapid expansion of large automated feeding operations on the Texas High Plains where thousands of animals are concentrated in localized areas has resulted in vast accumulations of solid waste. In 1973 the Texas High Plains feedlots produced in excess of 3 million tons of solid waste—enough to adequately meet the fertilizer requirements of 300,000 irrigated acres under high production. At a time when commercial fertilizer costs are increasing and with limited supplies in prospect for an indefinite period, the use of manure as a fertilizer merits serious consideration, particularly on lands near feeding operations.

Plant Nutrient Content and Chemical Characteristics

Barnyard cattle manure including bedding has been reported by many authors to contain approximately 10 lbs. nitrogen (N), 5 lbs. phosphorus (P_2O_5) and 10 lbs. potassium (K_2O) per ton. However, modern feedlots utilizing concentrated rations with little or no bedding produce wastes that are generally much higher in plant nutrients. The plant nutrient content of the waste is extremely variable, with the differences attributed largely to the ration, to waste management methods and to weathering conditions. Recent data concerning the composition of High Plains feedlot manure is shown in Table 1.

*Extension area soil chemist, Lubbock, and Extension area agronomists in Lubbock and Amarillo, respectively.

Availability of Plant Nutrients

Nitrogen

Nitrogen, generally the element of primary concern, is present in feedlot waste largely as organic nitrogen. Microbial decomposition changes organic nitrogen first to ammonium and then to nitrate, the form most readily utilized by plants. Rate of decomposition is a function of moisture, aeration and soil temperature. The decomposition rate is very slow near freezing and gradually increases with temperature up to 85 degrees.

Greenhouse and field studies with sorghum at Bushland indicate that about 120, 60 and 30 pounds of the 270 pounds present in 10 tons of manure is available for plant use during the first, second and third seasons, respectively.

Phosphorus and Potassium

Like nitrogen, the phosphorus present in manure is largely in organic form and becomes available for plant use only after biodegradation. The rate at which organic phosphorus is converted to

Table 1. Chemical analysis of manure samples from 23 feedlots[1]

	Range percent[2]	Average percent[2]	Pounds in 10 tons
Nitrogen (N)	1.16–1.96	1.34	268
Phosphorus (P_2O_5)	0.74–1.96	1.22	244
Potassium (K_2O)	0.90–2.82	1.80	360
Calcium (Ca)	0.81–1.75	1.30	260
Magnesium (Mg)	0.32–0.66	0.50	100
Iron (Fe)	0.09–0.55	0.21	42
Zinc (Zn)	0.005–0.012	0.009	1.8
Sodium (Na)	0.29–1.43	0.74	148
Water	20.9–54.5	34.5	6,900

[1]Mathers, A. C., B. A. Stewart, J. D. Thomas and B. J. Blair. 1973. Effects of Cattle Feedlot Manure on Crop Yields and Soil Conditions. Technical Report No. 11. USDA Southwestern Great Plains Research Center, Bushland, Texas.

[2]Based on moist weight or as obtained from feedlot.

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available inorganic form is not well established; however, numerous studies involving green manures and crop residues indicate the rate is similar to that of nitrogen. Potassium is present largely in soluble forms which are readily available for plant use.

It is highly probable that application rates sufficient to meet the crop's nitrogen requirement will be more than adequate to supply phosphorus and potassium requirements even on deficient soils.

Secondary and Micro Nutrients

Calcium and magnesium are present in significant amounts but are considered to be of little importance on High Plains soils known to be high in these elements.

Iron and zinc availability from manure in fields known to be deficient in these elements has not been adequately evaluated. It has been the observation of the authors that manure applications have not been effective in reducing the incidence of iron deficiency symptoms in sorghum the first year after application. While some writers have cited residual acidifying effects from manure, its use on the High Plains tends to make soils more alkaline. The effect this may have on micronutrient availability is not clear.

Feedlot Waste Versus Commercial Fertilizer

Inorganic commercial fertilizer developed within the last 100 years is one of the most vital inputs in crop production. The advantages, including effectiveness, convenience, abundant supply and low cost, have caused ready acceptance by the producer almost to the exclusion of manure application.

The decision as to whether manure or commercial fertilizer is to be used as a plant nutrient source should be based on, among other factors, the amount of each nutrient needed for a particular field and the cost of application. On the High Plains, most soils respond to nitrogen, 50 percent or less respond to phosphate and a very small percent can be expected to respond to potash.

If nitrogen should be the only nutrient of concern, decide first on the rate of nitrogen; then compare the cost of using manure with the cost of using commercial fertilizer, remembering the availability or release pattern previously discussed. If both nitrogen and phosphorus are needed, again decide on the rate of each element you want to apply and compare the costs of the carriers. Potassium can be included where applicable. If an analysis of the manure is not available, consider the average values.

Keep in mind the possibility that manure may have beneficial effects beyond its ability to supply nitrogen, phosphorus and potassium. The above suggestions apply only to these three elements.

Influence on Soil Properties

Continued annual applications of 10 to 15 tons per acre can be expected to have a favorable effect on soil physical properties. Increased water intake rate and water holding capacity as well as improved structure have been observed in manured soils. Good structure, or aggregate stability, contributes to a desirable root environment by improving aeration and ease of root penetration.

Precautions

Soluble Salt—As feedlot wastes undergo microbial decomposition, many types of salts are released. Some are absorbed by the soil while others remain in the soil solution.

Since feedlot waste is relatively high in soluble salts, high concentrations can build up in the seed zone in the upper lister bed following furrow irrigation. Salt accumulation from high application rates can adversely affect seed germination and plant growth by reducing the plant's capacity to utilize soil water. On the other hand, rainfall or sprinkler applied irrigation water tends to move the salts deeper into the profile, thus reducing the salinity hazard. It therefore is recommended that feedlot manures be applied in the fall so that the salinity hazard may be reduced by winter and spring rains.

Weeds—Weed infestations have frequently been credited to manure use. The number of viable weed seed in feedlot manures is greatly reduced by the heating and cracking processes involved in grain ration processing. However, roughages may contain weed seeds that could eventually be carried to the fields in viable condition. The hazard of weed seed dissemination in manure is lessened when wastes are stockpiled and allowed to undergo heating and some degree of decomposition before field application.

Recommended Use Practices

Time of Application—Feedlot waste can best be applied soon after harvest and ahead of initial land preparation when the land supports equipment well. Subsequent tillage operations should break up and incorporate the material into the soil to prevent nitrogen loss as ammonia and to insure placement of the phosphorus in the root zone.

Rates and Method of Application—Decisions as to amount to apply should be based on the quality of the manure, the crop to be grown and yield potential as influenced by adequacy of water and other factors. Based on the average plant nutrient content shown in Table 1, 10 to 15 tons per acre are generally adequate to produce near top yields of sorghum, corn and other crops having a high plant nutrient requirement.

Uniform distribution of material will contribute to a better planting situation and more uniform crop development.

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10M—2-74, New AGR 11