FARMYARD MANURE

Farmyard manure constitutes the most valuable by-product of the farm. It is estimated that 114,147,000 tons of manure exclusive of bedding materials are produced each year by the live stock in Canada. On the basis of average chemical analyses of the excrement from various species of animals, the nutrients in the total manure produced would be equivalent to 3,353,550 tons of sulphate of ammonia, 1,024,145 tons of superphosphate (20 per cent P_2O_5) and 1,137,825 tons of muriate of potash. In addition to these potential nutrients manure adds large quantities of valuable organic matter to the soil, thereby improving the tilth of both light and heavy soils.

Manure is a highly perishable product. This fact does not receive sufficient consideration and on many farms little or no attention is given to its care. The purpose of this pamphlet is to create a renewed interest in the valuable soil-improvement qualities of farm manure and to offer a few suggestions regarding its use, its susceptibility to loss and some practical methods of handling it in order to obtain its maximum benefits.

Value of Manure

Chemical Composition.—The approximate amount of nutrients in a mixture of fresh manure from the common species of farm animals is 10 pounds of nitrogen per ton of manure, 5 pounds of phosphoric acid and 10 pounds of potash. The phosphoric acid content of manure is relatively low in proportion to the other nutrients; hence it is frequently recommended that superphosphate be used to supplement the manure, either mixing with the manure in the stable or in the manure spreader, or applying as a direct dressing in the field.

Value of manure for crop production.—The value of manure may be calculated on the basis of its effect in increasing crop production. This effect varies considerably with different crops, varying soil-fertility levels and climatic conditions. An experiment conducted at the Central Experimental Farm, Ottawa, for a period of 27 years serves to indicate the yields of certain crops which may be expected following normal applications of manure made in connection with other recommended farm practices. On sandy loam soil two rotations of mangels, oats, clover and timothy were laid down side by side. One of these received no manure, and on the other manure was applied once in the four-year rotation to the mangel crop at the rate of 15 tons per acre.

The value of the crop produced in the two rotations was calculated from the average price for each crop each year and the average results for the 27-year period are presented in the following table:—

by Authority of Hon. J. G. Gardiner, Minister of Agriculture, Ottawa, 1941.

AVERAGE ANNUAL YIELDS AND VALUES OF CROPS ON MANURED AND UNMANURED LAND AT OTTAWA

Crop	Manured 15 tons per acre		No manure	
	Yield per acre	Value of crop	Yield per acre	Value of crop
		$ cts.		$ cts.
Mangels	22·76 tons	41 83	7·63 tons	15 42
Oats	59·9 bush.	29 03	44·7 bush.	19 93
Clover	3·80 tons	47 02	2·05 tons	25 70
Timothy	3·09 tons	38 28	1·93 tons	20 14
Total value of crops for rotation—(4 acres)	.....	156 16	.....	81 19
Average value per acre	.....	39 04	.....	20 30

The total value of crops in the rotation receiving no manure was $81.19, and where 15 tons of manure were applied the value was $156.16, an increase of $74.97 due to the manure. Thus the gross value of a ton of manure based on the value of increased crop in this experiment was $5. From this figure is deducted the cost of applying the manure and the cost of handling the increased crop. When these factors have been taken into account the value of the manure was $2.81 per ton.

Attention should be called to the fact that these are average figures. The yield and returns on the "no manure" area have consistently dropped off in recent years, and the difference in favour of the manure was considerably greater than the average figures indicate.

Losses from Manure

Manure is very perishable and subject to loss in a number of different ways. These losses may occur by:

1. Loss of the liquid portion of the manure through holes or cracks in the stable floor. This liquid portion contains a large proportion of the nitrogen and potash of the manure and these materials if purchased as commercial fertilizers are expensive.
2. Losses in storage are generally rather high even if great care is taken to follow recommended practices. In experiments by the Chemistry Division, Central Experimental Farm, Ottawa, it was found that manure stored for six months in a weather-tight shed lost 58 per cent of its organic matter, 19 per cent of its nitrogen and 3 per cent of its potash. In an exposed bin the loss was 65 per cent of the organic matter, 30 per cent of the nitrogen, 12 per cent of the phosphoric acid and 20 per cent of the potash.
3. Losses may occur in the field after the manure is spread, due to the effect of drying winds carrying away ammonia or to the loss of nutrients by leaching or erosion during periods of high rainfall.

Fresh versus Rotted Manure

Chemical analysis at the Central Experimental Farm, Ottawa, showed that mixed horse and cow manure fresh from the stable contained 0·60 per cent of nitrogen, 0·31 per cent of phosphoric acid and 0·78 per cent of potash. The same manure rotted for six months in a protected shed contained 1·69 per cent of nitrogen, 1·08 per cent of phosphoric acid and 2·60 per cent of potash. On the other hand, there was a loss of 71 per cent in the total weight of the manure. Thus, although the concentration of nutrients was higher in the rotted manure the total amount of nutrients in the pile was actually less than in the fresh manure.

Although chemical analyses showed a higher concentration of nutrients in rotted manure, this is not reflected in increased yields when applied to field crops. An experiment conducted at the Dominion Experimental Farm, Agassiz, British

Columbia, for a period of six years showed that 20 tons per acre of rotted manure applied to mangels in a rotation of mangels, oats, clover, timothy, produced yields which were not significantly higher than those from an equal application of fresh manure. Fresh manure is better suited to clay soils and heavy loams than to light soils since its coarseness does much to improve their physical condition by opening them to the air and making them more friable. On the other hand, rotted manure is better suited to light sandy soils, tending to make them more compact and retentive of moisture.

Fresh manure may be used with advantage for crops which have a long season of growth, such as mangels, corn or perennial crops. Rotted manure with its more available plant food gives better results for grain crops, which gather their food and reach maturity during a short period. Where a large number of weed seeds are present it may be desirable to rot the manure, as experiments by the Field Husbandry Division, Central Experimental Farm, Ottawa, showed that rotting for one month or more, completely killed the seed of common weeds except in a thin layer at the outside of the pile.

Care and Preservation of Farm Manure

As manure is so valuable for maintaining crop production and as losses in its plant food can take place so readily, its care and preservation cannot be emphasized too strongly.

Litter.—Since the first loss which may occur in manure is that of the liquid portion, care should be taken that the floor of the stable is water-tight. The next precaution is to provide sufficient litter or bedding material to absorb entirely the liquid. Straw is probably the most satisfactory bedding material and is available on most live-stock farms. If sufficient straw is not available, however, it may be supplemented or replaced by dry sawdust, fine shavings, peat moss or dried peat. Superphosphate scattered thinly on the stable floor lessens the odours of the stable, absorbs some liquid and improves the balance of plant food of the manure.

Storage of Manure.—While it is usually recommended that manure be drawn to the field and spread each day as it comes from the stable, circumstances may make it necessary to store the manure for a time. It may be desirable to store it to kill weed seeds, to place it in a pile to prevent loss from washing on sloping ground or to rot the manure before applying it to sandy soils. Where such a necessity arises, care should be taken to store the manure so as to reduce losses to a minimum. Several points should be kept in mind in this connection.

1. Experiments have shown that manure stored in a covered shed to protect it from the rain losses less of its nutrients than when stored in the open.
2. Where no such roof or protection is available the manure should be stored on a water-tight floor of concrete, having a side wall 14 inches high to prevent losses through drainage.
3. Manure in storage should be kept compact either by driving over the heap or by allowing live stock to tramp over it.
4. The heap should be kept sufficiently moist to prevent undue heating. In regions of high rainfall it is usually not necessary to add water, but where the heap becomes dry it is advisable to add some water. This is particularly true of horse manure, which dries out and heats readily.
5. Once the heap of manure has become compact it is not advisable to move it until ready to be spread on the field, as disturbing the pile increases fermentation and loss.

Preventing losses in the field.—Manure should not be spread on a sloping field until it can be immediately incorporated into the soil by disking or ploughing. If left on the surface exposed to the rain, considerable loss will result from washing. To prevent loss due to drying winds the manure should be worked into the soil as soon after application as possible, or if the manure is applied in winter incorporation into the soil in the early spring is advisable.

Methods of Applying Manure

Unless the manure is infested with weeds it is usually desirable to draw it fresh from the stable to the field each day. Where snow does not prevent its use, the manure spreader is the most satisfactory implement for drawing and spreading manure. Where a manure spreader is not available or cannot be used, manure may be spread by hand directly from a wagon or sleigh.

As a general rule a suitable rate at which to apply manure is 4 tons per acre per crop in a rotation. Thus a three-year rotation would receive 12 tons per acre and a five-year rotation 20 tons. The manure should be incorporated into the soil as thoroughly as possible but not too deeply. Disking it in or ploughing it in to about 4 inches deep is recommended.

Place in Rotation to Apply Manure

A number of factors must be considered in deciding what crop in the rotation should receive the application of manure. As the crop receiving the manure will respond more than subsequent crops, the most valuable crop should be the one to receive the manure. Hoed crops such as mangels, turnips, potatoes and corn respond to manure more than does hay, while grains and especially oats show the least response.

In experiments at three Experimental Stations in Eastern Canada, 16 tons of manure per acre applied to corn in a rotation of corn, oats, clover, timothy, produced a slightly higher total yield for the rotation than where the application was divided and 8 tons were applied to corn and 8 tons top-dressed on clover hay. At Charlottetown, Prince Edward Island, 20 tons of manure per acre were applied during a 21-year period to various crops in a four-year rotation of potatoes, oats, clover, timothy.

The yields from several of the treatments are shown in the following table:—

Place in Rotation of Applying Manure at Charlottetown, P.E.I.

Treatment	Yield per acre 21-year average				1913-1926
	Potatoes	Oats	Clover	Timothy	Value of crops produced*
	bush.	bush.	tons	tons	$ cts.
Check	98·7	42·5	0·77	0·82	90 51
20 tons for potatoes	229·2	53·4	1·58	1·42	178 18
10 tons for potatoes, 10 tons top dressed for oats	179·2	52·3	1·83	1·61	158 79
20 tons top dressed on clover stubble	177·1	47·9	1·34	2·00	154 23
20 tons top dressed on oats in spring	146·1	53·3	2·15	2·02	152 48

* Potatoes 49 cents per bushel, oats 51 cents per bushel, hay $1·288 per ton; average price in Prince Edward Island, 1913-1936.

The results of the above experiment showed that potatoes responded to manure to a much greater extent than did other crops. In addition the crop had a much higher cash value than the oats or hay and in this rotation there is no doubt that the manure should be applied to the potatoes. This is shown in the higher value of $178.18 for the rotation where 20 tons of manure per acre were applied to the potato crop. Where manure was top-dressed on oats the yield of grain was not increased but that of the hay in both cases was considerably higher. This was largely due to the fact that there was less winter-killing of the plants when manure was applied in this way. Applying 20 tons of manure per acre as a top dressing on oats gave a total value for the rotation of $152.48.

While it is usually preferable in a short rotation to apply all of the manure to one crop, in a five- or six-year rotation it may be advisable to apply two-thirds of the manure to the hoed crop and one-third as a top dressing for hay.

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