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MANURES AND COMPOST

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Animal manure, green manure (consisting of crops turned under), and compost (made from decomposed plant material and household garbage) have been used and recognized as excellent soil improvers for many years. Manures and compost supply plant nutrients and enrich the soil with humus-forming material, which improves the tilth of both sandy and clay soils.

ANIMAL MANURE

Animal manure was once one of the main sources of nutrients for crop production. The manure was collected, stored, and spread on the land. The amount of land being cultivated was in proportion with the number of farm animals producing manure, so that the manure was used up at rates favorable for crop production without risk of pollution. Now, however, because of the high cost of labor, farmers growing cash crops find it more economical to rely on commercial fertilizer as the main source of plant nutrients. For similar economic reasons, farmers producing animals now tend to concentrate large numbers of beef and dairy cattle, swine, and poultry on small areas of land. This concentration means that in many operations, odors sometimes result that adversely affect neighboring residents. When suitable storage for the manure is not provided and excessive amounts are applied to the relatively small land areas available for fertilization, high concentrations of nutrients in the runoff from these farms may cause nearby waters to become polluted or enriched, a process known as eutrophication. Information on manure management for intensive animal operations is given in the *Canada animal manure management guide,* Agric. Can. Publ. 1534. Although management is a problem in these larger operations, animal manure is a valuable source of plant nutrients and organic matter, and its best use is in the production of crops.

The following information on manure is confined mainly to solid manure, which is a mixture of animal excrement and an ample amount of animal bedding, or animal excrement alone that has been naturally or artificially air-dried.

Quantity Produced

According to the *Canada animal manure management guide,* the average number of tonnes of manure produced yearly by various farm animals are 10 for a horse, 13 for a cow, 1 for a sheep, 1.8 for a hog, and 0.05 for a laying hen.

The *Census of Canada,* 1971, listed the animal population of Canada as 316 000 horses, 2 507 000 dairy cattle, 11 153 000 other cattle, 998 000 sheep, 7 374 000 swine, and 97 401 000 poultry. These figures show that many millions of tonnes of animal manure are produced in Canada each year.

Composition

Manure consists of the excreta (urine and feces) from farm animals mixed with bedding, when such material is used. The feces is the undigested portion of animal feed, whereas the urine contains products of digestion.

The agricultural value of manure depends on the amount of organic matter, nitrogen, phosphorus, potassium, and other constituents in it, and on the physical effect it has on the soil. Its composition depends not only on the proportions of excreta and

TABLE 1. COMPOSITION OF FRESH MANURE produced by animals provided with ample bedding (on a wet-weight basis)

			Nutrient content					
	Proportions of components		Nitrogen (as N)		Phosphorus (as P_2O_5)		Potassium (as K_2O)	
Components of manure	%	kg/t	%	kg/t	%	kg/t	%	kg/t
Horse								
Feces	60	600	0.55	3.3	0.30	1.8	0.40	2.4
Urine	15	150	1.35	2.0	trace		1.25	1.9
Bedding (straw)	25	250	0.50	1.3	0.20	0.5	1.00	2.5
Total mixture	100	1000	0.66	6.6	0.23	2.3	0.68	6.8
Cow								
Feces	63	630	0.40	2.5	0.20	1.3	0.10	0.6
Urine	27	270	1.00	2.7	trace		1.35	3.7
Bedding (straw)	10	100	0.50	0.5	0.20	0.2	1.00	1.0
Total mixture	100	1000	0.57	5.7	0.15	1.5	0.53	5.3
Pig								
Feces	49	490	0.55	2.7	0.50	2.5	0.40	1.9
Urine	33	330	0.60	2.0	0.10	0.3	0.45	1.5
Bedding (straw)	18	180	0.50	0.9	0.20	0.4	1.00	1.8
Total mixture	100	1000	0.56	5.6	0.32	3.2	0.52	5.2
Sheep								
Feces	60	600	0.75	4.5	0.50	3.0	0.45	2.7
Urine	30	300	1.35	4.0	0.05	0.2	2.10	6.2
Bedding (straw)	10	100	0.50	0.5	0.20	0.2	1.00	1.0
Total mixture	100	1000	0.90	9.0	0.34	3.4	1.00	10.0

bedding, but also on the type of bedding material used; the kind, age, and function of the animals producing the manure; the kind of feed eaten by the animals; and the care taken in storing the manure.

Table 1 shows the approximate proportions of feces, urine, and bedding found in manure when ample bedding is used, and gives the amounts of nitrogen, phosphorus, and potassium in these components. There are large differences between the nutrient content of the feces and that of the urine, and also among the manures of various animals.

The percentage of nitrogen and potassium is much higher in urine than in the feces. Because the nutrients in urine are in solution, they are more readily available for plant use than those in the feces, which are mainly insoluble. The nitrogen in urine (present mostly as urea) is quickly converted into available plant food, whereas the nitrogen of the undigested feed in the feces is changed more slowly. Slightly more than half of the nitrogen and much more than three-quarters of the potassium excreted by the cow are in the urine, whereas most of the phosphorus is in the feces. The urine and feces of poultry manure are voided together as a moist mass, and only a small amount of urine may be lost by drainage. An average estimate of the chemical composition of fresh poultry manure is 1.47% nitrogen (as N), 1.15% phosphorus (as P_2O_5), and 0.48% potassium (as K_2O) on a wet basis (Papanos, S., and Brown, B.A. 1950. Poultry manure, its nature, care and use. Univ. of Conn. (Storrs) Agric. Exp. Stn. Bull. 272). The moisture content of fresh poultry manure is about 75%.

Besides the three major plant nutrients, manure also contains appreciable quantities of trace elements. Trace elements are nutrients that are needed in only very small amounts, but these amounts are essential for plants to develop normally. For example, if boron is deficient in the soil, turnips develop brown heart; if manganese is deficient, oats develop gray speck; if molybdenum is deficient, cauliflowers develop whiptail.

Forty-four samples of farmyard manure collected from experimental farms across Canada were analyzed at Ottawa for six trace elements. The average for boron was 20 ppm of dry matter; manganese, 201; cobalt, 1; copper, 16; zinc, 96; and molybdenum, 2. These results show that regular applications of manure should prevent or delay the appearance of disorders due to a deficiency of a trace element.

Factors Influencing Composition

The composition of manure varies with the kind of animal producing it. Cow manure has a lower total content of fertilizing elements than do the manures of other animals. However, the large volume produced makes it the most important one for mixed farming. Horse manure contains more nitrogen, phosphorus, and potassium than cow manure does, but because horse manure is loose, it decomposes readily and may lose much of its valuable nitrogen.

Pig manure varies widely in composition according to the feed consumed. When the animal is fed high-protein feeds and is supplied with enough bedding to absorb all the urine, the manure is of high quality. The urine of the manure of pigs fattened on a high-protein diet contains a high percentage of nitrogen, sometimes as much as 1%.

Sheep manure is usually very rich; it contains about twice as much of the plant nutrients as cow manure does. Because it is concentrated and can be distributed easily, it is of special value for topdressing and enriching the soils of gardens, lawns, and golf courses. For such specialized purposes, sheep manure is commonly dried and pulverized. It then contains about 13% water, 67% organic matter, and 20% ash or mineral matter plus sand or other filler material. Its plant nutrient content is 2.3% nitrogen (as N), 1.0% phosphorus (as P_2O_5), and 1.3% potassium (as K_2O). The nutrient content of dried sheep manure is about four times that of fresh cow manure.

Poultry manure is the richest manure produced on the farm, partly because of the kind of feed eaten by the birds. Fresh poultry manure contains two or three times as much nitrogen and three to eight times as much phosphorus as fresh cow manure does. Apply only one-third to one-half as much poultry manure as cow manure.

The composition and quality of manure from each kind of animal depend mainly on the kind of feed the animal eats. The richer the feed is in proteins, the richer the manure is in nitrogen. Similarly, the more phosphorus and potassium in the feed, the more of these constituents occur in the manure. The digestibility of the diet also affects the quality of feces and urine. Protein from different sources vary in digestibility, thereby affecting the proportion of nitrogen in feces and urine. A liberal diet of nourishing feed produces not only a healthy animal but also a rich manure.

Bedding

Until recently, animals were customarily provided with bedding to keep them dry and comfortable and to soak up the urine. Now, however, other systems are also being used, which handle the manure in liquid or semisolid form without any or with only a small amount of bedding material. The various ways of handling manure for beef and dairy cattle, swine, and poultry are given in the *Canada animal manure management guide*.

The quantity and quality of the bedding being used affect the composition of the manure. The approximate percentages of fertilizing elements in the materials commonly used for bedding are given in Table 2.

TABLE 2. NUTRITIVE VALUE OF BEDDING

	Nutrient content, %		
Bedding	Nitrogen (as N)	Phosphorus (as P_2O_5)	Potassium (as K_2O)
Straw	0.5	0.2	1.0
Sawdust and shavings	0.4	0.3	0.7
Peat moss (air-dried)	0.8	trace	trace
Muck and peat (air-dried)	1.5	0.2	trace

Straw, commonly used for bedding, absorbs two or three times its weight of liquid. If straw is scarce, cut it up, because finely cut straw is more absorbent.

Dry sawdust and fine shavings are clean and satisfactory for bedding. Sawdust used in normal amounts does not harm the soil, but too much sawdust or straw may cause a temporary shortage of available nitrogen in the soil.

The sawdust of hardwoods decomposes faster and is richer in potassium and phosphorus than that of softwoods. No harm results from the slowly decaying softwood sawdust, if you supply the animals with just enough to absorb and retain the urine.

Peat moss makes very good bedding; it is soft and absorbs several times its weight of liquid. It has the added advantage of retaining ammonia, which forms when the manure ferments.

Air-dried muck and peat are excellent absorbents that have been used effectively. These materials occur naturally in many parts of Canada and their value for bedding is well known. They are usually used as supplements to other bedding materials and are especially valuable in the gutter for absorbing urine. These naturally occurring absorbents markedly increase the bulk and value of the manure by adding organic matter and nitrogen.

Preserving and Storing

Manure may start to decompose just as soon as it has been voided. The rate of fermentation depends mainly on the methods of handling and storing. If ample bedding is supplied and the manure is left in a loose heap through which air passes, manure ferments fast and loses nitrogen in the form of escaping ammonia.

Decomposition occurs rapidly in the case of horse manure particularly, and, to a lesser extent, sheep manure. These manures ferment readily because they are loose in texture and contain more undigested food than other manures. To prevent excessive losses, keep the heap of horse manure compact and moist.

Preservatives such as superphosphate and peat may help to prevent loss of nitrogen in the form of ammonia and also to reduce the odors in the stable. They are usually scattered in the manure gutter.

Superphosphate increases the phosphorus content of the manure and also absorbs much of the ammonia. Spread superphosphate in the gutter at about 0.5 kg/day for each 450 kg animal. Manure is lower in phosphorus content than in nitrogen and potassium. By increasing the phosphorus content with the use of superphosphate as a preservative, you improve the balance of the three major plant nutrients.

Poultry manure ferments very quickly. If left exposed to air, it loses up to half of its nitrogen within 30 days. Therefore, to conserve nitrogen, poultry manure should not be stored any longer than necessary. For the best use of any manure, work it into the surface soil as soon as possible after application.

In broiler operations, the sale of manure can be an important addition to income, especially if there is a market for it at nearby nurseries and market gardens. The product is then probably easier

TABLE 3. NUTRIENT LOSSES IN ROTTED MANURE, determined after 3 and 12 months, with and without protection

	Nutrient loss			
	After 3 months		After 12 months	
Nutrient	Protected	Exposed	Protected	Exposed
	kilograms			
Organic matter	480	520	531	605
Nitrogen (as N)	3.6	6.4	5.0	8.6
Phosphorus (as P_2O_5)	no loss	0.9	0.5	1.8
Potassium (as K_2O)	no loss	6.4	0.9	10
	percentage			
Organic matter	55	59	60	69
Nitrogen (as N)	17	29	23	40
Phosphorus (as P_2O_5)	no loss	8	4	16
Potassium (as K_2O)	no loss	22	3	36

Note: Amount of manure used in the study was 3630 kg, containing 879 kg organic material, 21.8 kg nitrogen (as N), 11.3 kg phosphorus (as P_2O_5), and 28.1 kg potassium (as K_2O).

to sell as compost than as fresh manure. Composting eliminates objectionable odors, flies, and feathers. To compost the litter, pile it up, keep it moist, and turn it over several times a month.

In some areas, dried poultry manure is also sold in bags for use in home gardens. In some cases, it is compressed into pellets. These procedures may become more common in future if market demand increases.

The leaching away of urine during collection and storage of manure should be prevented. More than half of the nitrogen and much more than three-quarters of the potassium excreted by the cow, for example, are in the urine. Because these fertilizing elements are readily available, they are the most valuable portion of the manure.

These nutrients are leached out of manure when it is exposed to heavy rains. In districts where rainfall is heavy, manure should be stored under cover, if possible, and on an impervious surface such as concrete to prevent seepage of the urine. When the runoff from a manure pile is allowed to escape, the loss of soluble, readily available plant nutrients is great. Fermentation and leaching sometimes reduce the nutrient content of the manure by more than half.

In an experiment at the Central Experimental Farm, Ottawa, some years ago, approximately 3.6 t of a mixture of equal parts of horse and cow manure was placed in a weathertight shed. An equal amount was exposed to the weather in an open box with flooring and sides of wood in good condition. Table 3 shows the amounts of fertilizing elements that were lost in each case. The chief losses occurred during the first 3 months of rotting. After 12 months, about 10% more organic matter was destroyed in the exposed than in the protected manure, and nearly twice as much nitrogen was lost. The losses of phosphorus and particularly of potassium from the exposed manure were large.

Besides the loss of valuable nutrients, leaching from improperly collected and stored manure may contribute to the pollution of nearby water. Water enriched with nutrients and organic matter can cause the growth of algae that deplete the water of oxygen. Additional information on controlling pollution by proper handling and storage of manure is given in the *Canada animal manure management guide*.

Comparison of Fresh and Rotted Manure

When manure rots, the fertilizing constituents of the bedding become more readily available for plants. Fermentation also changes the organic matter into substances that more readily form humus in the soil, increases the availability of the phosphorus, and destroys most of the weed seeds that may be present. However, some fertilizing constituents are lost even when rotting occurs under good conditions. Weight for weight, rotted manure is more valuable than fresh manure, because it contains a larger percentage of plant food elements in more readily available form. But the losses incurred during the rotting process may outweigh the benefits. Generally, the sooner the manure is incorporated into the soil the better. However, it is better to store manure during the winter than to leave it lying exposed on the surface of the frozen ground.

To rot manure in a large heap, keep the pile compact. Compactness and the right amount of moisture keep losses to a minimum and make good manure.

Fresh manure is better suited to clay and loam soils because its coarseness improves their physical condition by opening them to the air and making them more friable. Rotted manure is better suited to sandy soils, tending to make them more compact and better able to hold moisture.

Fresh manure may be used for crops that have a long growing season. Rotted manure, with its more readily available plant food, gives better results for crops that mature quickly and are marketed early.

Value of Manure for Crop Production

The current prices of plant food elements in 1 kg of fertilizer are about 58¢ for nitrogen (N), 75¢ for phosphorus (P_2O_5), and 29¢ for potassium (K_2O). Calculated at these prices the value of all the nutrients in each tonne of manure, based on the analyses of manure from various animals given in Table 1, is $7.53 for horses, $5.98 for cows, $7.16 for pigs, and $10.67 for sheep. Similarly, the value of poultry manure is $18.55 a tonne. Besides these major nutrients, manure contains essential micronutrients and humus-forming material. Also, portions of the nutrients in manure are not as readily soluble as those in fertilizer and are released more slowly to provide a continuing supply of nutrients.

Table 4 shows the results of an experiment at Ottawa, Ont., where various amounts of manure and fertilizer were compared for four crops in a 4-year rotation of silage corn, oats, clover, and timothy. The figures show that manure at 18 t/ha applied to the corn increased its yield more and had a greater beneficial residual effect on subsequent hay crops than did fertilizer at 900 kg/ha containing about the same amount of nutrients as the manure. When half of the manure (18 t/ha) was applied to the corn and the rest to the oat stubble, the yields of hay increased over that obtained with the single application of 36 t/ha to the corn.

TABLE 4. YIELDS OF CROPS GROWN IN 4-YEAR ROTATION WITH AND WITHOUT MANURE on a sandy loam soil at Ottawa, Ont., 1956—63

Treatment	Crop yield			
	Corn (t/ha)	Oats (hL/ha)	Clover (t/ha)	Timothy (t/ha)
No manure or fertilizer	32.7	65	4.50	3.92
8-5-10 fertilizer applied to corn, 900 kg/ha	38.3	65	5.60	3.88
Manure applied to corn, 18 t/ha	42.6	64	6.00	4.55
Manure applied to corn, 36 t/ha	42.8	69	7.03	4.59
Manure applied to corn, 18 t/ha; and manure applied to oat stubble, 18 t/ha	41.4	68	7.39	5.89

Apply the manure to the most valuable crop in the rotation, because that crop responds more than do subsequent crops. Row crops and hay show greater response to manure than grain does. In a short rotation it is usually best to apply all the manure to one crop, but in a 5- or 6-year rotation it may be advisable to apply two-thirds of the manure to the 1st-year row crop and one-third as a top-dressing for hay. Apply 7—9 t/ha for each crop in the rotation. Thus, to a 3-year rotation apply 21—27 t/ha, to a 4-year rotation 28—36 t/ha, and to a 6-year rotation 42—54 t/ha.

Applying Manure to the Soil

To avoid losses of valuable fertilizing constituents, incorporate the manure into the soil just as soon as practical, particularly on a sloping surface. If manure is left exposed on the surface of slopes subject to erosion or on flat surfaces where flooding occurs, it may contribute to the pollution of nearby waters by adding nitrogen, phosphorus, organic matter, and bacteria.

Where animal production operations are carried out on a small land area, the amounts of manure produced often exceed the fertilizer requirements of the crop. If the manure is applied to the soil in excess as a convenient means of disposing of it rather than using it only in the amount needed, it may create a pollution hazard.

Therefore be sure to have enough crop land available in cultivation to ensure that the nutrients in the manure, particularly nitrogen, are utilized and not leached out sufficiently to contaminate the groundwater. For example, it has been estimated at the Department of Land Resource Science, University of Guelph, Guelph, Ont., that 20 ha of land cultivated for corn is the smallest area that can safely assimilate the yearly amount of manure produced by 100 dairy cattle, 200 feeders, or 10 000 laying hens, without causing pollution in Ontario. Ask your local provincial agricultural representative for advice on the maximum rates of manure application for various cropped soils in your area.

GREEN MANURE

Green manure is the term used for a green crop that has been turned under to improve the condition of the soil. Green manuring is a means of returning to the soil the plant food that was removed by the crop, and of enriching the soil with humus-forming materials. Nutrients such as phosphorus, potassium, and calcium are taken by the roots of some plants from depths below the plow layer; when the crop is plowed down, these nutrients are returned to the soil closer to the surface, where the next crop can reach them easily.

Green manure crops have another value: they prevent soluble nutrients in the soil from leaching away in the drainage water by using them in their growth. Nitrates particularly, which are highly soluble and readily leached, are conserved in this way. Also, in seasons when the soil would otherwise be left bare, a green manure crop reduces erosion by wind and water. Besides conserving nutrients, green manure crops help prevent the enrichment and pollution of nearby waters.

Legumes such as clover and vetches are popular as green manure crops because they can take up and use nitrogen from the soil atmosphere with the aid of special bacteria in the nodules or tubercles on their roots. At the Central Experimental Farm, Ottawa, the foliage and roots of a vigorous crop of clover was found to contain 110—170 kg of nitrogen per hectare. Much of the nitrogen was taken from the atmosphere, and when the entire crop was turned under the amount of nitrogen in the soil was increased. In an experiment conducted at Charlottetown, P.E.I., potatoes receiving 1120 kg of 4-8-10 fertilizer per hectare were grown after both fallow and clover in 3-year rotations. The yield of potatoes was 245 hL/ha on clover sod, 22 hL/ha higher than that of the crop after fallow. When the clover crop was plowed under instead of harvested, the yield of potatoes increased to 264 hL/ha.

Green manure is most valuable where specialized cash crops are grown. For example, tobacco is grown on sandy soils in a rye—tobacco rotation in which the fertilized rye crop is worked back into the soil to maintain its organic matter and fertility. In small-fruit and vegetable production, fertilized green manure and clover crops are used effectively to improve the productivity of the soil.

In mixed farming, however, where regular field crops are grown, it is uneconomical to sacrifice a regular crop for green manure. Green manure alone cannot build up a run-down soil or even maintain the fertility of a relatively good soil. If the soil is very poor, a good, green manure crop cannot be grown without adding plant food such as barnyard manure or commercial fertilizer. And if the soil is fertile enough to produce a luxuriant growth of a green manure crop without additives, the land does not need the nutrients gained by plowing the crop down. These crops are best fed to livestock; when the manure produced by the animals and the residue from the crop are returned to the land, they are usually able to provide the necessary humus-forming material for good crops.

COMPOST

On many farms and market gardens, people often neglect or waste materials that could be used as humus-forming compost. Garden refuse, leaves, and household garbage are satisfactory sources of compost. They can be applied directly to the soil, where they will eventually rot; but because decomposition is often slow, it is better to compost them first.

Waste materials can be composted with or without manure. If you use manure, spread the raw materials on the ground in a strip 30—45 cm deep and 2.5—3 m wide. The amount of waste available determines the length. Cover the raw material with 15—30 cm of manure. Continue spreading alternate layers of waste and manure until the heap is no higher than 1—1.5 m. If you use loose vegetable material, keep the heap compact and moist but not saturated. After it stands for a few weeks, turn and mix the heap and repile it to keep the mixture uniform. Repeat the procedure about once a month; after 3—6 months the compost is ready for use.

The preparation and handling of a compost heap is not difficult, but to get good-quality compost you must follow carefully these simple rules.

- Keep the waste material compact and moist. In districts of low rainfall, such as certain areas of the Prairie Provinces and British

Columbia, it is very hard to get satisfactory results unless a supply of water is available for moistening the heap.

- To prevent contaminating the soil with weed seeds, do not put ripened weeds in the compost heap. If the weeds are green and the seeds have not matured, they may safely be added to the heap.
- Do not add garden or crop refuse affected by diseases, such as clubroot of cabbage and turnips, because you will spread the diseases.
- Be careful not to add any soil that has been used in the greenhouse or frames unless you are certain that it is free from root disease germs, eelworms, and similar sources of trouble.
- Tramp each new layer of refuse to compact it, especially if it contains a lot of dry material, such as leaves.

When the waste materials are composted without manure, they rot faster if some food is supplied for the bacteria that bring about the rotting. Add about 2 kg of garden fertilizer and 0.5 kg of limestone for each 50 kg of waste material, and mix it evenly through the heap. In an experiment at the Central Experimental Farm, Ottawa, straw was converted to artificial manure by this method. About 3.75 kg of a fertilizer mixture was used for each 50 kg of straw. Rotting began within a week after constructing the compost pile, as shown by a rapidly rising temperature. After 3 months the pile had shrunk noticeably. The straw had darkened in color, was well broken down, and resembled coarse, strawy manure. When this artificial manure was compared with barnyard manure for use on a potato crop, the yields were almost the same. The chemical compositions of artificial manure and average barnyard manure are given in Table 5.

TABLE 5. COMPOSITION OF ARTIFICIAL AND BARNYARD MANURES

	Nutrient content, %		
Manure	Nitrogen (as N)	Phosphorus (as P_2O_5)	Potassium (as K_2O)
Artificial	0.37	0.22	0.10
Barnyard	0.50	0.25	0.50

In another experiment the waste products used were corn stover (with fertilizer added), Sudan grass (with fertilizer added), and corn stover mixed with pasture clippings (without fertilizer). The fertilizer consisted of 25 kg of ammonium sulfate, 20 kg of superphosphate, and 15 kg of ground limestone, which were mixed with 1 t of waste. Water was added to keep the composts moist. After 11 months, the composts had all decomposed enough to be satisfactorily used as manure. The composts were analyzed, and the results, calculated to a 75% moisture content, are given in Table 6. For comparison, analyses of fresh cow manure and well-rotted manure, containing about the same amount of water as the decomposed compost, are also given. Although the amounts of plant nutrients vary in the three composts, the approximate value of the components compares favorably with that of fresh cow manure. All the composts and the fresh cow manure contain much less potassium than does well-rotted manure. The addition of 5—7.5 kg of muriate of potash to the fertilizer mixture when the compost heap is being prepared corrects this deficiency. The compost from uncut corn stover and pasture clippings contained only a small amount of phosphorus because no fertilizers were added, but, even so, it contained more than the fresh cow manure. However, the addition of the fertilizers is best because it improves the nutrient balance of the manure.

TABLE 6. COMPARISON OF NUTRIENTS IN COMPOST AND MANURE

	Nutrient content, kg/t		
Kind of compost or manure	**Nitrogen (as N)**	**Phosphorus (as P_2O_5)**	**Potassium (as K_2O)**
Composts			
Uncut corn stover (with fertilizer added)	3.4	7.6	1.0
Uncut corn stover and pasture clippings (no fertilizer added)	4.4	2.9	1.2
Sudan grass (with fertilizer added)	7.3	6.4	1.2
Manures			
Fresh cow manure	5.7	1.4	4.9
Well-rotted manure	7.8	6.9	8.4

To use farm and garden wastes as described in this publication, remember that, apart from the plant-food content, the chief object is to convert the coarse vegetable material to a form that makes good humus. Compost improves the physical and biological condition of the soil and supplies major and minor plant nutrients.

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm^2)	x 0.15	square inch
square metre (m^2)	x 1.2	square yard
square kilometre (km^2)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm^3)	x 0.06	cubic inch
cubic metre (m^3)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2,5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl. oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre