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HS973

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Guidelines for Purchase and Application of Poultry Manure for Organic Crop Production [1]

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Poultry manure and poultry litter (manure with bedding) is commonly used as a soil amendment and nutrient source for organic crop production. However, unless a farmer has an on-farm poultry facility, manure must be outsourced and delivered to the farm. Purchase, delivery, and application of these materials involve food safety, legal, regulatory, nutrient availability, and handling issues. Information on these topics can be found in Extension publications from university departments of agronomy, agricultural engineering, food science, horticulture, and poultry science. The purpose of this publication, however, is to integrate this information to provide guidelines and references for organic farmers who use outsourced poultry manure or litter in organic crop production.

Definitions

The National Organic Program (NOP) Final Rule was published in the Federal Register (Volume 65, Number 246) on December 21, 2000 and is available at http://www.ams.usda.gov/nop/indexIE.htm. An index to the subparts of the NOP is also available at http://www.nal.usda.gov/afsic/ofp/7cfrtoc.htm. Standards on raw animal manures can be found in Subpart C, Section 205.203, Soil Fertility and Crop Nutrient Management Practice Standard.

Within the text of the National Organic Program and its Final Rule as published in the Federal Register, the definition of manure is "feces, urine, other excrement, and bedding produced by livestock that has not been composted."

Raw animal manure must be composted unless it is:

1. Applied to land used for a crop not intended for human consumption.
2. Incorporated into the soil not less than 120 days prior to harvest of a product whose edible portion has direct contact with the soil surface or soil particles.
3. Incorporated into the soil not less than 90 days prior to harvest of a product whose edible portion does not have direct contact with the soil surface or soil particles.

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Since tree crops like citrus may have low hanging fruit that may or may not come into direct contact with soil or soil particles, following the 120 day rule is a reasonable application of the above criteria.

By NOP definition compost is the product of a managed process through which microorganisms break down plant and animal materials into more available forms suitable for application to the soil. Compost must be produced through a process that combines plant and animal materials with an initial carbon:nitrogen (C:N) ratio of between 25:1 and 40:1. Producers using an in-vessel or static aerated pile system must maintain the composting materials at a temperature between 131°F and 170°F for 3 days. Producers using a windrow system must maintain the composting materials at a temperature between 131°F and 170°F for 15 days, during which time, the materials must be turned a minimum of five times.

Approximate C:N ratios of common materials that can be used in composting manure are presented in Table 1. Accurate C:N ratios can be determined by sending samples of plant and animal materials to a commercial laboratory before beginning the composting process. Alternately, growers could estimate the relative C:N ratios of materials received from different sources and develop a formula for appropriate C:N ratios that can be verified by laboratory analysis.

An important distinction in the NOP is therefore made between "manure or raw manure" and "compost," with composted manure being referred to as "animal materials" and along with composted plants as "plant and animal materials." According to this definition, manure has not been composted, even if it has a relatively low moisture content and is relatively dry. Since poultry manure can include feathers, bedding and feed material, and dead birds, the term "animal waste materials" is used in this publication as a more inclusive term for both uncomposted and composted poultry manure and poultry litter, subject to the already mentioned limitations.

Purchase of Animal Waste Materials

Outsourced animal waste material are often purchased in large loads of 20 tons or more delivered by a semi-tractor trailer that dumps the entire load at one site. Endloaders, backhoes, and trackhoes are commonly used to load material into field spreaders. Before outsourcing animal waste material, it is important to obtain information concerning the following paramiters:

1. pH
2. bulk density
3. percent moisture
4. plant nutrient level (N-P-K and other nutrients)
5. stage of aerobic decomposition (if the animal waste materials have undergone composting or aging)
6. verification that the animal waste materials do not contain materials prohibited by the NOP Final Rule
7. confirmation that the animal waste materials do not contain human (e.g. *E. coli*, *Salmonella*) or plant pathogens (e.g. plant parasitic nematodes and other pathogens)
8. verification that the animal waste materials contain no pesticide residues in excess of NOP rules (5% of maximum residue limits (MRL) stated by the Environmental Protection Agency)

Generally, as the percent moisture of animal waste materials decreases, the percent nutrient content increases (Table 2). Animal waste materials with a lower moisture content will therefore usually have a higher nutrient content (i.e. more pounds of nitrogen, phosphorus, and potassium) than wastes with a higher moisture content. Furthermore, analysis of nutrient levels in dry animal waste materials (expressed as a percent by weight) usually discloses higher nutrient content or more lbs/ton nitrogen, phosphorus, potassium, and other nutrients than in wet materials. To quantify animal waste material composition after delivery, material should be analyzed using sampling methods referred to in Table 5 and sent to a university

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or commercial lab for analysis. These analyses will confirm nutrient application at rates originally planned for in the nutrient management plan. Note also that organic production rules in Europe differ from NOP regulations. For example, marketing criteria for countries within the European Union (EU) prohibit the use of animal material from livestock from factory farms.

Most growers outsource animal waste materials for delivery to the farm. If mishaps occur during transit and the load of materials is spilled on highways or private property, the farmer may be responsible for cleanup if he has already assumed ownership of the materials. When outsourcing such material, it is important to determine exactly when the buyer assumes ownership (upon purchase or upon delivery) and to define this in the contract language. Ideally, ownership will transfer at the time animal waste materials are delivered to the farm, however, you may have to consult a lawyer to clearly define conditions of purchase, ownership, and delivery.

The major expense in outsourcing is usually transportation costs, with costs decreasing as load size increases. Transportation costs vary with round-trip mileage from the source and reflect load weight and volume, tolls, degree of difficulty encountered during delivery of material to the farm, and the economics of backhaul loads. With the major concentration of broiler operations in north Florida and cage layer operations in central and southern Florida, many farmers have access to animal waste materials at reasonable costs.

Delivery of Animal Waste Material

Another consideration is the type of trailer used to deliver animal waste materials. Both dump and walking-floor tractor trailers are used. Dump trailers use hydraulic lifts to raise the front end of the trailer (Fig. 1). On slopes and soft soils, dump trucks can become unstable when the trailer floor is fully raised. In some situations, especially on moist or otherwise unstable soils, dump trailers and attached road tractors have fallen over during unloading, causing property damage and personal injuries. The walking-floor trailers remain stable during loading and dump animal materials by shifting portions of the trailer floor without lifting the trailer.

Figure 1. Delivery of poultry manure with dump truck trailer.

Before animal material is delivered, an on-farm delivery and storage site should be carefully selected to avoid site pollution, especially possible leaching of plant nutrients into surface water or into soil horizons above shallow water tables. In citrus groves adjacent to wetlands, some growers have constructed impermeable dump sites with a cement floor and three side walls to prevent off-site movement of nutrients.

Roads and turn-around areas must also accommodate 30-55 foot trailers with loaded tandem-axle road tractors weighing nearly 40 tons. The site should provide easy access for equipment used to reload manure into truck spreaders and tractor-pulled spreaders. Avoid areas with overhanging power lines or tree limbs and sites that do not allow easy access from more than one direction. Animal waste materials should be as close as possible to the application site and should not be dumped on or close to county or state roads, environmentally sensitive areas, locations adjacent to wells or dwellings, fresh produce fields, or packing houses. The minimum distances necessary can depend on a number of factors, including farm layout, location of wells, residences, outer buildings, slope of the land, runoff potential, environmental sensitive areas, forecast of heavy winds and rainfall, quantity, and storage of animal waste material. Additional suggestions about the use of animal waste materials, especially in terms of production of fresh fruit and vegetables can be found in the following USDA publication, *Guide to Minimize Microbial Food*

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Safety Hazards for Fresh Fruits and Vegetables, cited in Table 5.

Application of Animal Waste Material

Animal waste materials usually contain the primary plant nutrients, nitrogen (N), phosphorus (P), and potassium (K), the secondary plant nutrients calcium, sulfur, and magnesium, and minor plant nutrients zinc, copper, boron, iron, and manganese. However, nutrient analysis can vary, depending on many factors, including the composition of animal feed materials, the type of poultry operation, flock size, flock replacement cycle, animal waste material management, storage method, and moisture content. Moisture content may be the most important factor to consider in terms of weight or bulk density of the animal material, with total N ranging from 26 to 72 lbs/ton; P_2O_5 from 17 to 28 lbs.ton; K_2O from11 to 46 lbs/ton (Table 3).

Determination of animal waste material application rates depends on several factors, including nutrient content, crop nutrient removal rate, application method and placement, and the phosphorus index developed by the National Resource and Conservation Service (NRCS) cited in Table 5. This Index is a method for assessing the risk of off-site phosphorus movement that may impact surface or ground water quality. Using critical parameters of soil, topography, and material application management that influence phosphorus movement, this index can help select alternatives that minimize the environmental impact of animal waste material application.

Current nitrogen availability models for animal wastes incorporated into Florida soils suggest that 50% of applied nitrogen will be available within one year after application with 10 and 3% being available within 2 and 3 years, respectively, after application. For example, Table 4 demonstrates pounds of nitrogen available for crop use with an initial application of 62 pounds per ton of broiler litter applied each year for five years, including holdover amounts from previous years. Table 5 also lists a fact sheet, *Calculating Manure and Manure Nutrient Application Rates*, that may be of help in determining initial and subsequent year application rates. It should be noted that there is little evidence that commonly used application rates for animal materials (5 to 25 tons/acre/year) will significantly increase soil water or nutrient holding capacity or nutrient levels and that increases in these soil parameters with very high rates (>50 tons/acre/year) are rapidly lost by rapid organic matter decomposition under Florida conditions.

Animal waste materials are frequently broadcast on pasture lands, in row middles in citrus groves, and in vegetable fields before and/or after bedding. The drawback of broadcast applications is that unless the animal waste material is incorporated into the soil within about 12 hours, volatilization of inorganic N can occur, with the amount of loss depending on the time between application and incorporation. Shallow grove disks can be used to incorporate material into soils when tree roots are close to the surface. Tractor-drawn sidedress or row mulching equipment (Fig. 2) has also been used to band animal material within the root zone of fruit trees, resulting in optimum placement of plant and animal materials for efficient nutrient uptake. Some growers have also applied mulches overe banded material to reduce N loss.

Figure 2. Application of poultry litter with a row mulcher.

When animals waste materials are banded, application rates per acre can refer to the treated area (area to which materials are applied) rather than to a gross acre. For example, a gross acre of citrus trees on the central Florida Ridge may contain 150 trees planted within an acre ($43{,}560^2$). However, the

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treated area may include only 4 feet on either side of each tree, considerably reducing the treated area to about 33% of each gross acre.

Manure spreaders are similiar to dry, granular fertilizer spreaders and can be calibrated correctly when a swath width is determined along with spread pattern and application rate. Careful calibration can ensure good nutrient management and utilization of animal materials as well as protection of ground water quality and buffer zones. The University of Georgia has an excellent publication listed at the end of this fact sheet entitled *Calibration of Manure Spreader Including Swath Width*.

Food Safety and Marketing

Recent concerns about organic agricultural production practices and food safety focus on proper management practices for animal waste materials to ensure minimum risks of microbial contamination of fruits and vegetables. The *Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables* (Table 5), already mentioned, outlines essential risk reduction considerations that are incorporated into Good Management Practices (GMP). These GMPs are supported by Good Agricultural Practices (GAP) identified in the 2000 publication, Food Safety Begins on the Farm (Table 5).

Marketing agreements frequently require third party certification of Good Agricultural Practices (e.g. the European Retailers Partnership - Good Agricultural Practices or EUROGAP)[3] to audit management practices relative to food safety. Many standards refer to Hazard Analysis Critical Control Points (HACCP) principles as the basis for hazard analysis of physical chemical or biological hazards that are reasonably likely to cause illness, injury, or death unless control is established. Successful economic marketing of organic crops may depend upon implementation of these standards with risk analysis. Information about these may be obtained from USDA-NOP accredited certification agencies.

Animal Waste Materials and Your Neighbors

A University of Georgia fact sheet on the above topic, referenced in Table 5, contains additional tips on maintaining and improving good public relations when using manure.

- Cover litter that is transported on public highways to prevent spillage and blow out.
- Cover stored litter to improve nutrient retention and reduce leaching of nutrients from wet manure as well as to reduce odor and fly problems.
- Maintain a buffer zone of 100 feet between manure piles and drinking water sources.
- Consider weather conditions and wind direction before spreading poultry litter. This may require flexibility in scheduling manure applications but can also allow for more uniform placement and prevent manure drift or misapplication on adjacent properties.
- Spread in the morning hours to allow for greater drying and dissipation of odors during the day.
- Inform surburban neighbors when you plan to spread manure and avoid spreading poultry litter on weekends, holidays, and on other occasions when you may be likely to offend neighbors.
- Incorporate litter into the soil as soon as possible after application to decrease odor and fly problems.
- Finally, be proactive in developing good relations with neighbors. For example, reward tolerant neighbors with a token of your appreciation like some free manure for their garden or free produce from your fields.

Additional Notes:

3. EUREP: European Retailers Partnership - Good Agricultural Practices or EUROGAP is an organization of of leading European food retailers. GAP stands for 'Good Agricultural Practices,' a minimum production standard for good agricultural practices for horticultural products. EUREP uses GAP as production standard for the certification of good agricultural practice in the agricultural and horticultural industry.

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Table 1. Carbon:Nitrogen ratios of materials commonly used in composting.

Hardwoods	560:1
Hardwood bark	223:1
Poultry manure	5-15:1
Sawdust	200-700:1
Softwoods	641:1
Softwood bark	496:1
Straw	40-150:1

Table 2. Average plant nutrient content of cage layer poultry manure at different manure moisture levels.

Moisture (%)	**Nitrogen (N)**		**Phosphorus (P_2O_5)**		**Potash (K_2O)**	
	lbs/ton	**%**	**lbs/ton**	**%**	**lbs/ton**	**%**
95	10	0.50	7	0.35	3	0.15
75	30	1.50	20	1.00	10	0.50
50	40	2.00	40	2.00	20	1.00
30	60	3.00	55	2.75	30	1.50
15	100	5.00	70	3.50	40	2.00

Source: Pennsylvania State University Special Circular 315. These values assume no moisture loss and no litter.

Table 3. Average nutrient composition of chicken manures.[1]

Manure type	**Total N**	**Ammonium (NH_4-N**	**P_2O_5**	**K_2O**
	Broiler (lbs/ton)			
Fresh (no litter)	26	0	17	11
Broiler house litter	72	11	78	46
Breeder house litter	31	7	54	31
Stockpiled litter	36	8	80	34
	Layer (lbs/ton)			

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Table 3. Average nutrient composition of chicken manures.[1]

Manure type	Total N	Ammonium (NH_4-N	P_2O_5	K_2O
Fresh (no litter)	26	6	22	11
Undercage scraped	28	14	31	20
HIghrise stored	38	18	56	30

[1] Source: Pourltry Manure as a Fertilizer Source. North Carolina State University Fact Sheet, Ag 439-5 at http://www.anam.gob.pa/documentos/recopilacion/pdf/ia14.pdf and Poultury Manure as a Fertilizer at http://edis.ifas.ufl.edu/AA205

Table 4. Pounds of animal manure nitrogen available during initial and subsequent application years beginning with 62 lbs N/ton[1].

Pounds of N available per ton of applied manure (Year)					
Annual applications	**1**	**2**	**3**	**4**	**5**
1st	31	6	3	0	0
2nd		31	6	3	0
3rd			31	6	3
4th				31	6
5th					31
Total	31	37	40	40	40

[1]50, 10 and 3% of applied nitrogen available during years 1, 2, and 3, respectively, after application.

Table 5. Sources for additional information on poultry manure.

Topic	Publication
Collecting a Poultry Litter Sample for Analysis	http://edis.ifas.ufl.edu/HS189
Poultry Manure as a Fertilizer	http://edis.ifas.ufl.edu/AA205
National Resource and Conservation Service (NRCS) Phosphorus Index	http://www.nrcs.usda.gov/techincao/ECS/nutrient/pindex.html
Handling Poultry Litter and Your Neighbors	http://department.caes.uga.edu/poultry/tips/tipssep01.htm
Food Safety Begins on the Farm	http://www.hort.cornell.edu/commercialvegetables/issues/foodsafe.html
Loading of Phosphorus in Surface Runoff in Relation to Management Practices and Soil Properties	Soil and Crop Science of Florida Proceedings. 62:12-20.
Calibration of Manure Spreaders Including Swath Width	http://www.engr.uga.edu/service/extension/publications/c825-cd.html
Calculating Manure and Manure Nutrient Application Rates	http://www.ces.purdue.edu/extmedia/AY/AY-277.html