Comparisons of Manure, Compost, and Commercial Fertilizers

by Clain Jones, Extension Soil Fertility Specialist
clainj@montana.edu (406) 994-6076

Manure, Compost and Fertilizer

All 3 materials provide crops with N, P, and K, so why choose one over the other?

- Differences in nutrient content
- Effects on plant yield, vigor and health
- Effects on soil tilth
- Transportation, application and cost differences

- **Commercial fertilizers :** AA, AN, UAN, UR (Urea) MAP, DAP etc.
- **Manure:** No explanation needed!!
- **Compost**: Decomposed/stabilized organic matter

Compost examples include:

- ***Food Processing Residuals***—compostable material remaining after fruit, vegetables, grains, nuts, and meat are processed for consumption.
- ***Manure and Agricultural By-Products***—originate at feed lots, on the farm, and in greenhouses. Large quantities of manures and/or plant residues are generated and can pose a severe disposal problem.
- ***Forestry and Forest Product Residuals***—includes bark and sawdust, and fiber fines, residue and biosolids generated by the papermaking process.
- ***Biosolids, or Sewage Sludge***—the solid material generated by the biological treatment of sewage at a wastewater treatment plant. In addition to being composted, sewage sludge can be recycled for beneficial use by direct application to land as a fertilizer.
- ***Leaves, Brush and Yard Trimmings (Yard Waste)***—typically consists of leaves, brush, and grass clippings common to urban areas.

Source The Composting Council Research and Education Foundation (CCREF)

Commercial Fertilizers

Advantages

- Precise amount of N, P, K
- Available in a range of nutrient levels (especially when blended) to provide the producer what is needed for the crop
- Uniform material for ease of transport and application
- Known properties of the material with predictable effect on crops
- Widely available

Commercial Fertilizers

Disadvantages

- Costs vary and change during the year, and are currently at record highs

- Often have higher chance for nutrient runoff or leaching, because of high solubility

Manures

Advantages

- Often free (except for transport/application)
- Adds organic matter (OM) to the soil which improves structure, increases water holding capacity, increases CEC and reduces erosion
- Provides both available and ‘slow-release’ N, P, K and micro-nutrients to crops

Manures

Disadvantages

- Nutrients can be easily leached through the soil profile or volatilized if left on the surface
- Nutrient content is highly variable
- May introduce human pathogenic bacteria such as fecal coliform or E.coli
- May introduce weed seeds
- Weight and bulk of transporting and applying wet manures to fields

How is Manure Typically Handled?

Manure is often surface applied, incorporated or injected into the soil without processing, and applied at maximum allowable quantities to avoid building extensive storage facilities.

These rates vary widely due to manure types, soil type and method of application….Contact the NRCS for assistance in calculating manure application rates.

Montana NRCS State Office
(406) 587-6813

Online Manure Nutrient Calculator
http://www.agry.purdue.edu/mmp/webcalc/nutAvail.asp

Compost

Advantages

- Lower water content: greater total concentration of nutrients than manure on wet basis
- Adds OM that releases nutrients slowly
- High OM content improves soil structure, increases CEC and water holding capacity
  - *Greater water holding capacity may decrease irrigation needs and reduce pumping costs*
- Beneficial microbes in compost increase nutrient cycling and can suppress soil and foliar pathogens

Advantages to Compost, Cont'd

- Few to no pathogens & weed seeds due to the heat generated during decomposition
- Drier than manures with a reduced volume of 50-75%, making it easier to transport and apply
- Possible source of income for various markets and applications
  - Market examples: Compost can be used by home gardeners, mine reclamation sites, as seed starter and potting mixes for nurseries, as a soil amendment for landscaping.

Compost

Disadvantages

- Making compost involves costly equipment, planning, monitoring and time to produce
- Nutrient enriched leachate must be controlled to prevent runoff or ground water contamination
- May require special permits depending on quantity produced and if selling compost
- Will likely be more costly per lb of available nutrient than either fertilizer or manure

Making Compost

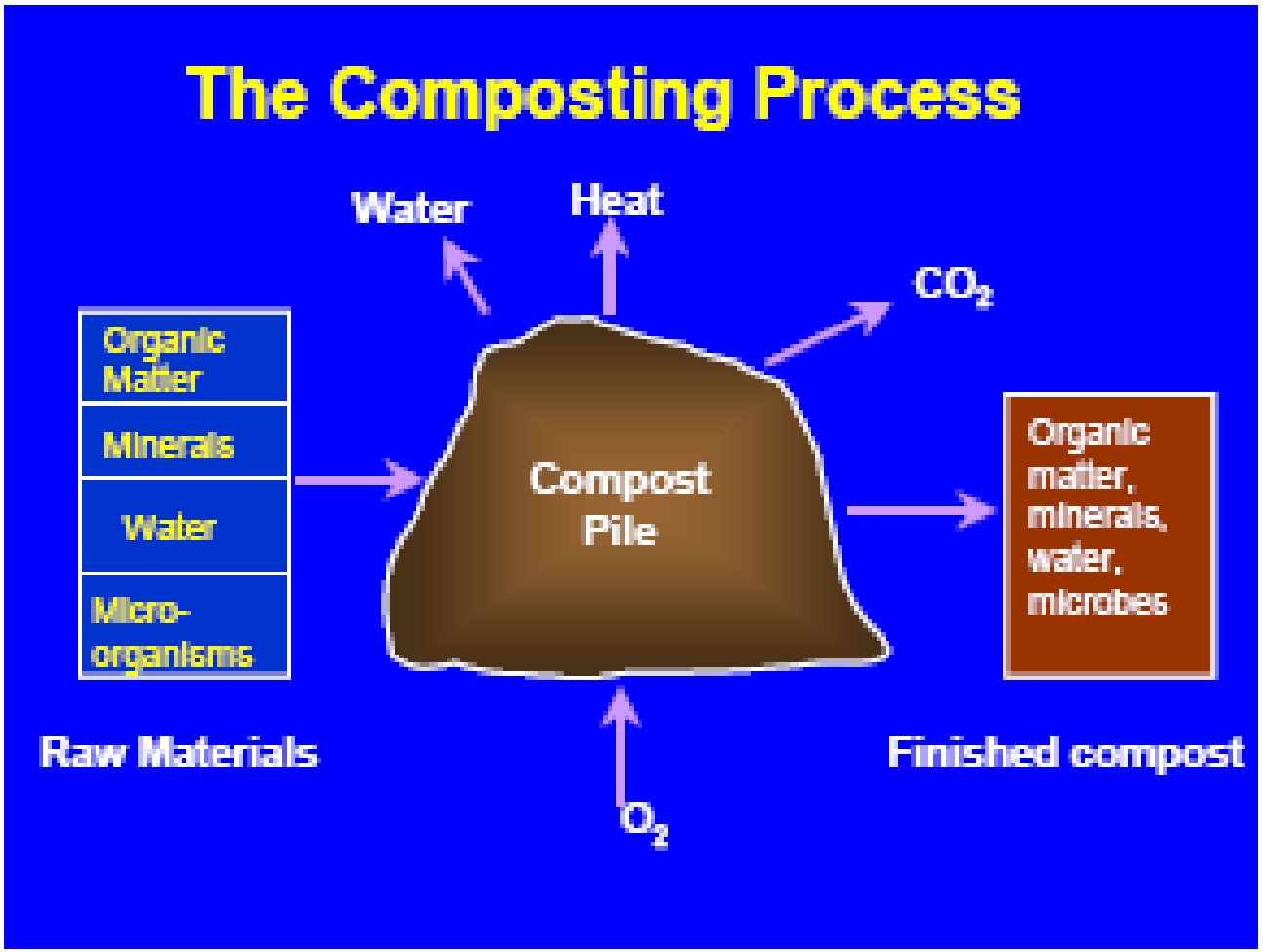


Figure 1. The Composting Process. Adapted from Rynk, 1992.

Typical Total Nutrients in Fertilizer

Fertilizer Sources	Frequently Used Abbreviations	% N	% P_2O_5	% K_2O
Anhydrous Ammonia	AA	82	-	-
Ammonium nitrate	AN	34	-	-
Urea-ammonium nitrate	UAN	28-32	-	-
Monoammonium phosphate	MAP	11-13	48-62	-
Diammonium phosphate	DAP	18-21	46-54	-
Potassium chloride	KCl	-	-	60
Urea	UR	46	-	-

(Modified from Havlin et al., 1999)

Typical Total Nutrients for Manure

National averages of nitrogen (N), phosphorus ($P_2 0_5$), and potassium (K_2O) values of manures based on a dry weight and a wet weight basis.*

		% Dry Weight			% Wet Weight		
Source	% Dry Matter	Total N	Total P_2O_5	Total K_2O	Total N	Total P_2O_5	Total K_2O
Dairy	15-25	0.6-2.1	0.7-1.1	2.4-3.6	0.1-0.5	0.1-0.3	0.4-0.9
Feedlot	20-40	1.0-2.5	0.9-1.6	2.4-3.6	0.2-1.0	0.2-0.6	0.5-1.4
Horse	16-25	1.7-3.0	0.7-1.2	1.2-2.2	0.3-0.8	0.1-0.3	0.2-0.6
Poultry	20-30	2.0-4.5	4.5-5.0	1.2-2.4	0.4-1.4	0.9-1.5	0.2-0.7
Sheep	25-35	3.0-4.0	1.2-1.6	3.0-4.0	0.8-1.4	0.3-0.6	0.8-1.4
Swine	20-30	3.0-4.0	0.4-0.6	0.5-1.0	0.6-1.2	0.1-0.2	0.1-0.3

*To determine actual amounts of nutrients, however, it is necessary to have the manure tested. **Source**: Knott's Handbook for Vegetable Growers. 1997. John Wiley & Sons, Inc.[4]

Typical Nutrients in Compost

Typical nutrient breakdown of finished compost

Nutrient	Dry Weight
Nitrogen (N)	<1% up to 4.5%
Potassium (K_20)	0.5% to 1%
Phosphorus (P_20_5)	0.8% to 1%
Calcium (Ca)	2% to 3%
Magnesium (Mg)	2% to 3%

Source: B.C. Agricultural Composting Handbook. 1998.

Nutrient concentrations in finished compost will vary depending on type of manure, plant residue or bio-solids used.

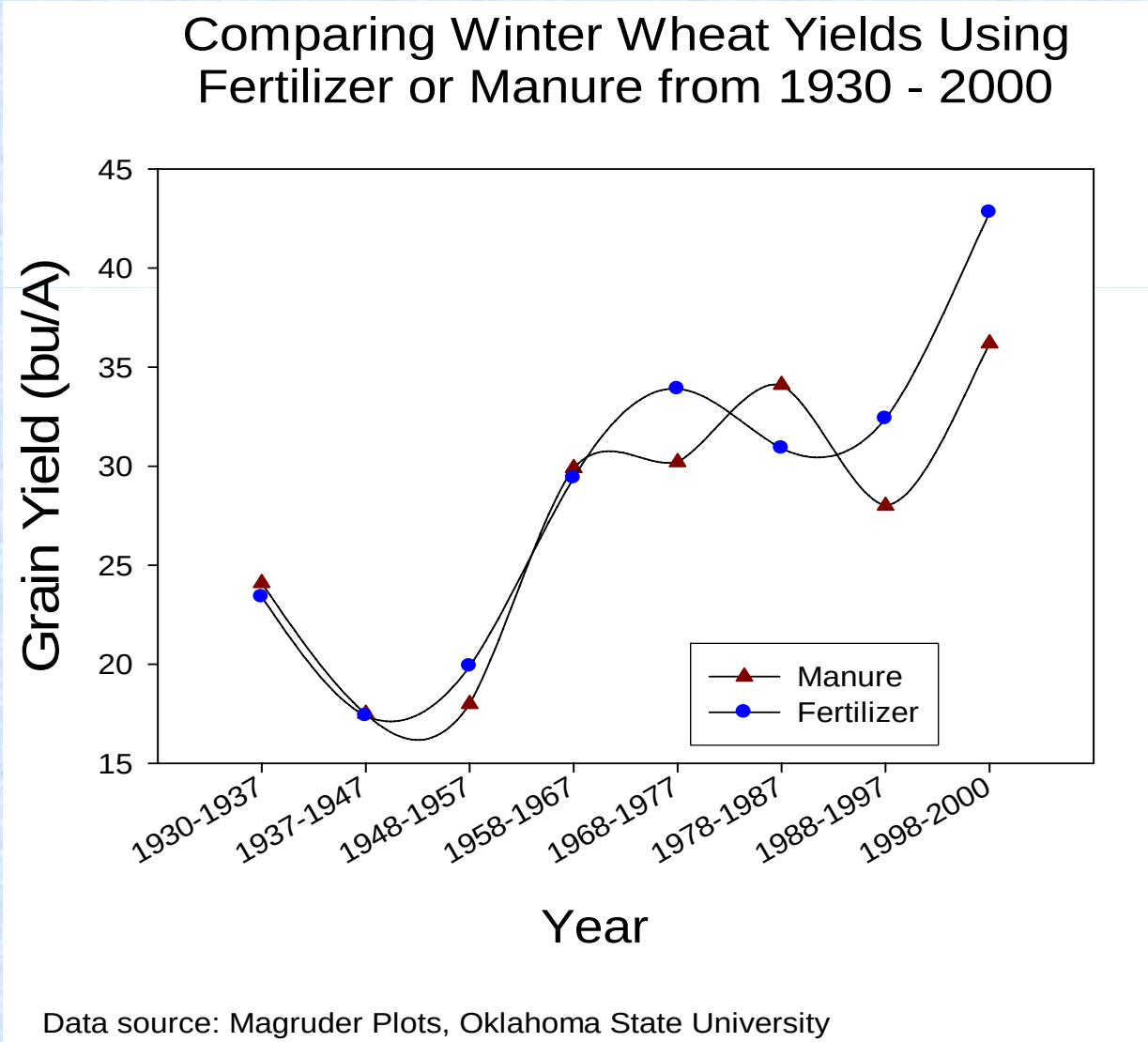
Nutrient Availability is Different for each Source

Type of Nutrient Source	Relative Nutrient Availability
Commercial Fertilizer	**High**
Manure	**High -Medium , depending on liquid/solid**
Compost	**Low, slow release of nutrients**

Comparing Yields Using Fertilizer vs. Manure

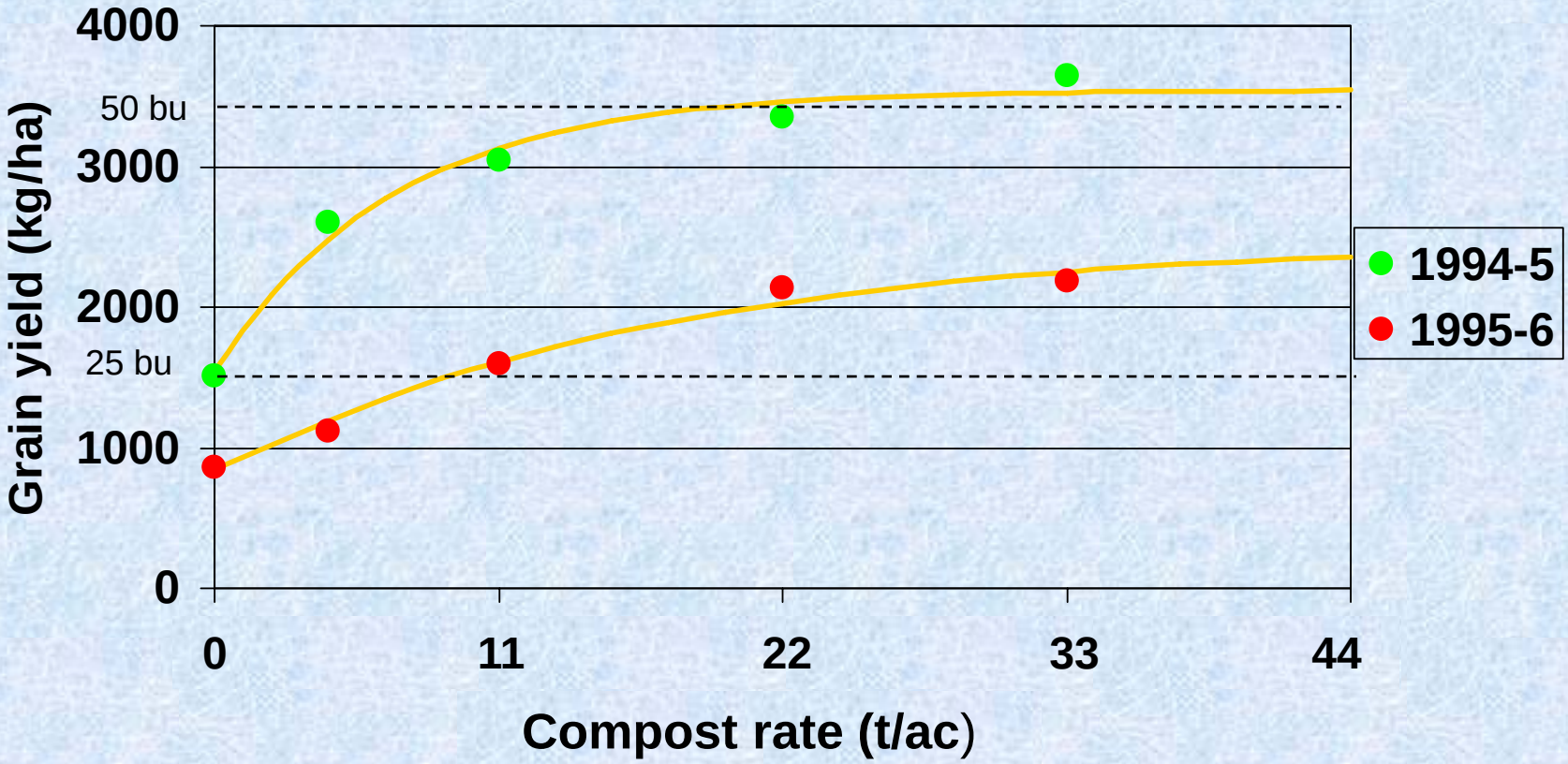
Annual fertilizer rates (lb/A) 33-30-30 (1930-1967), and 60-30-30 (1968-2000).

Manure applied every 4th year at rates of 120 lb/A (1930-1967) and 240 lb/A (1968-2000).



Data source: Magruder Plots, Oklahoma State University

Yield Response to Compost



A dryland wheat study in northern Utah. Data source: Koenig et al. (2003)

Utah Study on the Effects of Compost and Winter Wheat Yield

Conclusions from the study:

- In wet years, nutrient availability had greater effect on yield

- In dry years, the non-nutrient effects of compost (increased water holding capacity, lower bulk density, increased soil warming and greater aeration) had greater effect on yield

Compost Costs and Value

Compost Cost (from a local composter)	Compost Value, when Accounting for Total N,P,K at Current Fertilizer Costs
$12 / ton	$ 25 / ton*

* Compost average N,P,K content: 1%, 0.72%, 2.7% respectively

Fertilizer vs. Compost Costs

Fertilizer	Compost
For this example: Desired yield: 40 bu/ac WW Recommended rate of N at 64 lb/ac (soil nitrate-N analysis of 40 lb/ac), P_2O_5 at 45 lb/ac (Olsen P tested at 8 ppm) and K_2O at 40 lb/ac (K soil tested at 200 ppm)	For this example: Compost OM content = 37% Recommended rate of 17 tons /ac to increase SOM content by 0.60% (ex: 1.1% to 1.7%)
$ 46 /ac	$ 240 /ac
Each year	Only very occasionally, but likely will require supplemental fertilizer

Bottom line, costs for each will vary, depending on the producer's farming goals and soil nutrient status.

Summary

Decisions on fertilizer vs. manure vs. compost depend on:

- Having quantities or easy access to those materials.
- Comparing costs of fertilizer vs. manure vs. compost and their associated application costs.
- Providing the right amount of N, P, and K for your crop.
- Your choice on whether you want to build soil O.M. or not.

Resources…

Rick Fasching, agronomist, NRCS,
(406) 587-6837 richard.fasching@mt.usda.gov

Nutrient Management Self-Study Course (1-15), MSU Ag Extension publications: http://www.montana.edu/wwwpb/pubs/mt4449.html

Fertilizer Guidelines for Montana Crops EB 161, MSU Extension, Free.

Contact Extension Publications **(406) 994-3273** for ordering information or online at:

http://www.montana.edu/wwwpb/pubs/eb161.html

Gallatin Co. Extension Agent, Ron Carlstrom **(406) 582-3280**

MSU's Soil Fertility website:

http://landresources.montana.edu/soilfertility

Resources cont'd

Online Crop Fertilizer Recommendation Calculator
http://www.agry.purdue.edu/mmp/webcalc/fertRec.asp

Online Manure Nutrient Calculator
http://www.agry.purdue.edu/mmp/webcalc/nutAvail.asp

Compost for Manure Management a 77-page BioCycle report that focuses on turning livestock waste into a valuable soil amendment. $39.00 BioCycle/JG Press. www.jgpress.com

Troy Smith owner/operator of Earth Systems Organic Compost
(406) 287-3870 Manhattan, MT

Field Guide to On-Farm Composting, 1999
(NRAES–114, companion to the *On-Farm Composting Handbook* from NRAES (National Resource Agriculture & Engineering Service), $14.00.
www.nraes.org

Questions/Input?