DENVER BOTANIC GARDENS
Chatfield Farms

Water Efficient Agriculture in a Semi-Arid Environment

Larry Vickerman
Director
Denver Botanic Gardens
Chatfield Farms
Littleton, Colorado U.S.A.

DENVER BOTANIC GARDENS
Chatfield Farms

Water placement method is primary way to increase water efficiency

-Drip irrigation vs. overhead sprinkler saved 36% of total water used

-Use of reemay covers to protect new seedlings and lessen evaporation

DENVER BOTANIC GARDENS
Chatfield Farms

Utilizing plastic mulch

-Can increase water savings an additional 10-15%

-Reduces evaporation and competition from weeds

-Warms the soil for quicker plant growth in the Spring and enhances yield

Build soil organic matter

- Data from North America's longest running field experiment on the impacts of farm production methods on soil quality have revealed that high inorganic N inputs *deplete soil carbon, **impair soil water holding capacity*** – *and ironically, also deplete soil N*

DENVER BOTANIC GARDENS
Chatfield Farms

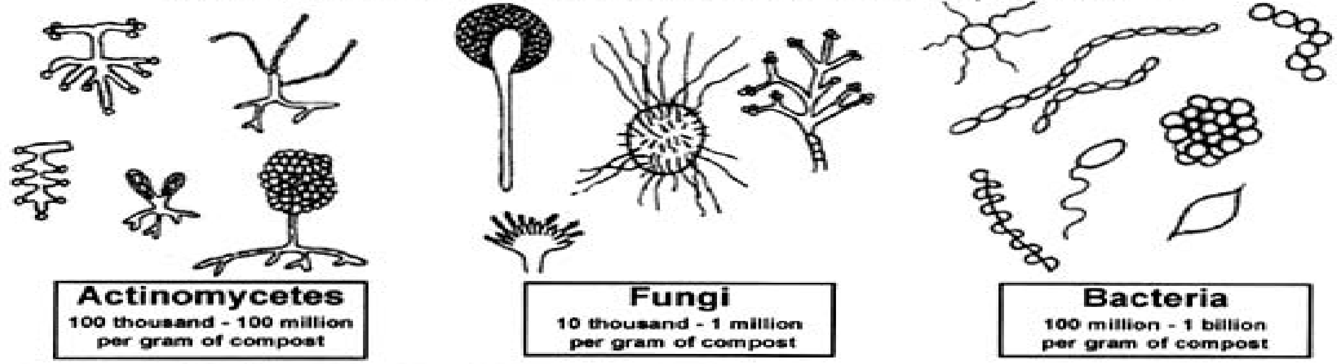
Addition of compost

-Improve water and oxygen infiltration into the soil

-Dr. Whendee Silver, UC Berkeley, documented an additional 900 lbs. of carbon sequestered in an acre of pasture land by top-dressing with ½ inch of compost and then grazing.

-The compost improved grass growth 25-50% and ***improved water retention an average of 2,800 gallons per acre.***

Figure 3.3
COMPOST MICROORGANISMS MAGNIFIED 1,000 TIMES



Reproduced with permission from On-Farm Composting Handbook. NRAES-54, published by NRAES, Cooperative Extension, 152 Riley-Robb Hall, Ithaca, New York 14853-5701. (607) 255-7654. Quantities of microorganisms from: Sterritt, Robert M. (1988). Microbiology for Environmental and Public Health Engineers. p. 200. E. & F. N. Spon Ltd., New York, NY 10001 USA.

Table 3.6
MICROORGANISMS IN COMPOST

Actinomycetes	Fungi	Bacteria
Actinobifida chromogena	*Aspergillus fumigatus*	*Alcaligenes faecalis*
Microbispora bispora	*Humicola grisea*	*Bacillus brevis*
Micropolyspora faeni	*H. insolens*	*B. circulans complex*
Nocardia sp.	*H. lanuginosa*	*B. coagulans type A*
Pseudocardia thermophilia	*Malbranchea pulchella*	*B. coagulans type B*
Streptomyces rectus	*Myriococcum themophilum*	*B. licheniformis*
S. thermofuscus	*Paecilomyces variotti*	*B. megaterium*
S. thermoviolaceus	*Papulaspora thermophila*	*B. pumilus*
S. thermovulgaris	*Scytalidium thermophilim*	*B. sphaericus*
S. violaceus-ruber	*Sporotrichum thermophile*	*B. stearothermophilus*
Thermoactinomyces sacchari		*B. subtilis*
T. vulgaris		*Clostridium thermocellum*
Thermomonospora curvata		*Escherichia coli*
T. viridis		*Flavobacterium sp.*
		Pseudomonas sp.
		Serratia sp.
		Thermus sp.

Source: Palmisano, Anna C. and Barlaz, Morton A. (Eds.) (1996). Microbiology of Solid Waste. Pp. 125-127. CRC Press, Inc., 2000 Corporate Blvd., N.W., Boca Raton, FL 33431 USA.

DENVER BOTANIC GARDENS
Chatfield Farms

- Composting and cover cropping has raised our S.O.M. from 1.5% to 5-7%

Plant-microbe bridge

- Compost inoculates soils with bacteria, fungi and actinomycetes
- Microbial activity drives the process of aggregation and enhancing soil structural stability
- Some carbon fixed by plants during photosynthesis is exuded by roots to feed soil microbes

DENVER BOTANIC GARDENS
Chatfield Farms

Keep live plants growing in the ground as much as possible.

- Utilizing cover and companion crops whenever a crop is not being grown
- ....to keep root exudates going to feed microbes that enhance availability of essential plant nutrients.

Ultimate Step:
Regenerative farming

-Keep mulch or debris on soil surface as much as possible.

-Eliminate tillage

-Maintain a high level of soil microbial life to cycle nutrients

-Reduce use of synthetic N & P fertilizers that inhibit the complex biochemical signaling between plant roots and microbes

DENVER BOTANIC GARDENS
Chatfield Farms

Larry Vickerman, Director

8500 West Deer Creek Canyon Rd.

Littleton, CO 80128

720-865-4337 Phone

720-865-4341 Fax

Vickerml@botanicgardens.org

www.botanicgardens.org

- Khan SA, Mulvaney RL, Ellsworth TR, Boast CW., 2007. The Myth of Nitrogen Fertilization for Soil Carbon Sequestration. Journal of Environmental Quality 36(2):1821–1832
- Mulvaney RL, Khan SA, Ellsworth TR., 2009. . Journal of Environmental Quality. 38(6):2295-314.
- Ryals R. and Silver W., 2013. Effects of organic matter amendments on the net primary productivity and greenhouse gas emissions in annual grasslands. Ecological Applications 23(1): 46-59.