Land Application of Organics:
Quantifying Greenhouse Gas, Soil and Water Benefits

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A wide range of organics can be used as feedstocks for compost production or for direct land application following anaerobic digestion. Anaerobic digestion extracts energy from organics while leaving nutrients and carbon in the material coming out of the digester. Materials can be digested in existing digesters at Wastewater treatment plants or at new anaerobic digesters. With the exception of animal manure digesters, co-digetion of feedstocks will produce solids that are similar to the biosolids already produced.

Tonnage of organics suitable for composting or digestion in King and Yakima Counties

	King County	Yakima County
Corn stover		10200
Mint slugs		36700
Hops residue		4300
Dairy manure	24400	115200
Cattle manure	4700	43850
Horse manure	26900	30200
Poultry manure	300	22700
Land clearing debris	70000	2400
Cull fruit		17000
Apple pomice		10100
Grape/fruit pomice		11000
Cheese whey	2400	11300
Beef processing	600	7000
Animal mortalities	150	1200
Fish waste	650	
Food waste	67000	7100
Yard non wood	147000	22000
Other organics	15500	800
Paper	729000	78500
Grease	11500	1400
Biosolids	30000	2200
Total (dry tons)	1130100	435150

Examples of feedstocks for compost or direct land application above and experimental and full scale composting below

Range in characteristics of biosolids and composts

	%C	%N	%P
Biosolids	15-35	2-7	1-3
Compost	15-35	1-2.5	0.5-2

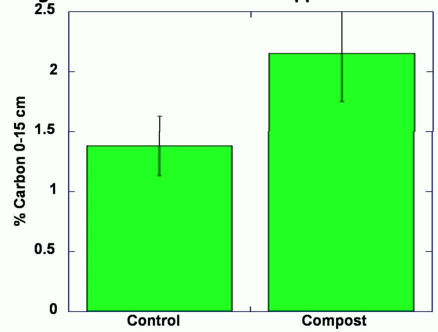
So what happens when you add organics to soils?
We looked at long-term experiments and farmers' fields on both sides of the Cascades to quantify benefits associated with use of organics. A list of sites that were sampled is shown below

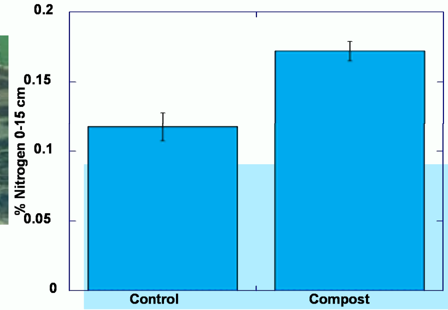
Site	County	Crop	Years of application	Treatments
Farm	Yakima	Cherry	2002-2008	Compost
Farm	Yakima	Grape	2002-2008	Compost
Farm	Yakima	Hops	2003	Compost
Farm	Yakima	Pear	2004-2008	Compost
Farm	Chelan	Apple	2006-2008	Compost
Farm	Chelan	Pear	1993-2008	Compost
Experiment	Douglas	Wheat	1994-2006	Biosolids
Experiment	Pierce	mixed shrubs	2001	Compost
Experiment	Pierce	mixed shrubs	2007	Compost, biosolids
Experiment	Pierce	turf	2000	Compost
Experiment	Pierce	turf	1993	Biosolids
Experiment	Pierce	turf	1993-2002	Biosolids

We saw benefits:

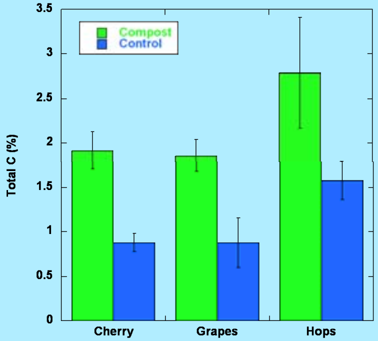
- Soil carbon sequestration
- Improved soil nutrient status
- Fossil fuel avoidance through use of organic sources of nutrients
- Improvements in soil tilth (as measured by bulk density)
- Increased plant available water

Our analysis of soil tilth and plant available water isn't complete but benefits of compost/organics use for carbon sequestration are consistent across all sites sampled. The increase in total soil carbon and nitrogen for all sites and all application rates is shown below



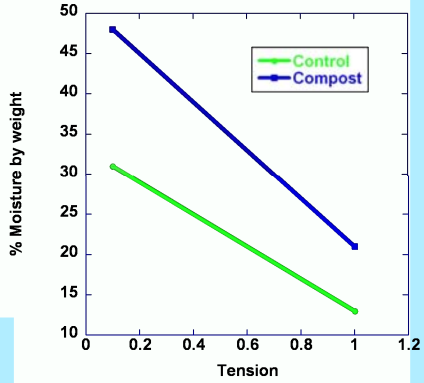


Cherries grown in Sunnyside, WA can be used as a representative example for all sites. Here, the farmer used compost made with fruit pomice, biosolids, hops waste, and food scraps. The compost has been applied under the trees annually since 2002 for a total application of 105 Mg ha^{-1}. For soil carbon, results for the cherries are similar to those for hops, grapes and pears



For the cherries, *each ton of compost applied sequestered about 0.75 tons of CO_2 in the soil.* This is in addition to the fertilizer benefits of about 60 kg CO_2 per ton

In addition to storing carbon, the compost reduced soil bulk density by 33% in comparison to the control soil.
The soils under the cherries also held 50% more available water than the controls.
Water will infiltrate a compost amended soil more quickly and stay longer in the soil profile.



In years with sufficient rainfall, biosolids increase yield in dryland wheat by 16% over synthetic fertilizers. Compost increased beet yield in an urban garden from 1 kg (control) to 6 kg)

What are the economic impacts of these changes in soil?
Washington grows cherries on 36000 acres with an annual crop of 124,000 tons. As of 2004, <1000 were organic. If compost was used on all of this acreage it would mean:

- Soil carbon reserve increase of > 1 million metric tons
- Conservative yield increase of 12.4 tons

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