



Direct Land Application of Uncomposted Green and Woody Wastes

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“Research to Evaluate Environmental Impacts of Direct Land Application of Uncomposted Green and Woody Wastes on Air and Water Quality”

- Yearlong study commissioned by CalRecycle and conducted by UC Davis
- Evaluated the environmental impacts of direct land application (DLA) of chipped and ground green and woody wastes (residential yard trimmings):
 - Analyzed GHG and VOC emissions
 - Compared the emissions between surface application and incorporation of green waste into soil
 - Assessed the migration of chemical constituents into the soil and soil water
 - Characterized the composition of these materials from seven facilities throughout the state



What is Direct Land Application?

- Application of uncomposted waste onto agricultural land
- Can produce GHGs and VOCs
- Outlet for municipally collected green waste
- Less expensive than compost
- Difficult to regulate
- May contain physical contaminants (i.e. glass, plastic, metal)
- Potential to spread pathogens
- May become an increasingly common practice in California.
- Air quality impacts have not been previously studied



CHIPPED BRANCHES

SHREDDED BRANCHES

SHREDDED LEAVES

Study Details

- **Field Study**

- Material from one Northern California green waste processing facility was applied to UC Davis farmland
- Green waste was processed to pass through a 5 inch screen
- 3 scenarios studied:
 - Surface application – 6 inches of material
 - Surface application – 12 inches of material
 - Soil Incorporation – 6 inch height of material tilled into soil at a depth of 6-8 inches
- Characterized air emissions and potential soil and soil water contamination

- **Laboratory Study**

- The environmental impacts of DLA were studied for different soil types and soil moisture conditions

- **Statewide Green Waste Characterization**

- An additional lab study was done to analyze green waste samples from six other facilities in Northern and Southern California for nutrient, bacteria, metal, and pesticide content

Volatile Organic Compounds (VOCs)

- VOCs were greatly reduced by soil incorporation compared to surface application
- The composition of VOC emissions was similar to that observed from compost piles
- DLA produces VOCs that tend more toward ozone formation than composting



Greenhouse Gases (GHGs)

- **Methane (CH₄):** emissions were negative
- **Carbon dioxide (CO₂):** emissions were higher with green waste scenarios as compared to bare soil; emissions were greatly reduced by soil incorporation compared to surface application
- **Nitrous Oxide (N₂O):** emissions were greatly reduced by soil incorporation compared to surface application
- **Oxygen (O₂):** application of green waste significantly increased O₂ consumption



Contaminant Migration

- All 3 scenarios were associated with an increase in nitrates in soil
- Nitrate leaching into soil water was only significant after saturating the soil with 4 inches of irrigated water
- Calcium and potassium in soil water were increased modestly after winter rains; the increase in the nutrients was less prominent after summer irrigations



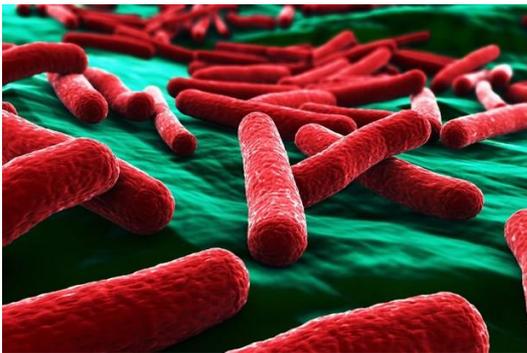
Soil Moisture

- Surface-applied green waste increased soil moisture as compared to bare soil
- Increased soil moisture lead to increased N₂O emissions
- The tilled treatment did not increase soil moisture as compared to bare tilled soil



Pathogens

- E.coli was detected in nearly all green waste samples, with 8 of 14 samples exceeding the EPA standard
- E.coli was not detected in the soil water
- Total coliform was found in a number of soil water samples, exceeding the EPA standard in the 12-inch surface application
- After time and at a distance of 12 inches below the surface, only total coliform could be found in the soil.
- Salmonella was undetectable in all green waste samples



Metals

- Arsenic, copper, lead, and zinc were not found in higher concentrations than background soil levels
- Soil water showed arsenic in concentrations higher than the drinking water standard of 10 parts per billion; however, these amounts are not far above what is typical for potable wells in the Davis area.
- Iron was detected in the soil water, as a result of the irrigation water containing iron



Pesticides

- Pesticides could not be detected, but this may be due to the small volume of water collected by the lysimeters during testing



Statewide Green Waste Characterization



- The composition from the 2 sampling events of chipped and ground green waste taken from all 7 facilities showed similarity for the material statewide
- The sample used for the field study was typical of what was available for delivery around CA



Results

- Soil incorporation of green waste has fewer environmental impacts than surface application
- DLA has the potential to spread pathogens, pests, and weed seeds that are typically found in green waste and destroyed by composting
- Because DLA has not been studied to the same extent as composting, it would be useful to extend this research



Questions?

