

VOLCANIC ASH INFORMATION 1

Prepared by Oregon State University's Agricultural Experiment Station and Extension Service. For more information, consult the OSU Extension Service in your county or the nearest branch Agricultural Experiment Station.

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PHYSICAL AND CHEMICAL CHARACTERISTICS OF MT. ST. HELENS ASH

Volcanic ash is a major constituent of many soils used for agriculture and forestry in Oregon. Nearly all Oregon soils have been influenced by volcanic ash. "Ashy" soils are common in other countries such as New Zealand and Japan.

Soils dominated by volcanic ash have similar properties. They are deficient in plant nutrients such as phosphorus and sulfur and contain comparatively large amounts of silica, an inert substance found in all mineral soils. Often, volcanic ash soils are porous which allows for free movement of water and mobile nutrients such as sulfate and nitrate. Plant roots readily penetrate and grow in these soils. They do not contain toxic substances that inhibit plant growth or affect the health of humans or animals. They tend to be dusty, as anyone who has camped in central Oregon will appreciate.

A major difference between the newly deposited ash from Mt. St. Helens and older ash from previous volcanoes is the soluble salt content. The newly deposited material contains significant amounts of soluble salts, such as sodium chloride and calcium sulfate, whereas these salts have long since been leached out of the older ash deposits. Observation of the Mt. St. Helens ash indicates that its soluble salt content is rapidly reduced by the leaching effect of rainfall.

Physical Properties

Similar to other volcanic ash the main constituent of Mt. St. Helens ash is pumiceous volcanic glass having a chemical composition very similar to dacite which is a common volcanic rock. Volcanic glass, which is nearly pure silica, makes up about 65 to 80 percent of the Mt. St. Helens ash. The proportion of glass is probably higher in the fine ash compared to the coarser ash. The ash also contains other minerals including 10-15% feldspars. These major constituents are quite insoluble and therefore don't readily release elements to the soil solution from which plants derive their nutrients. The Mt. St. Helens ash contains small amounts of free silica such as quartz and cristobalite.

Ash deposits vary in density depending on packing. An unpacked light gray colored sample of ash from the Ritzville, Washington area weighed 0.55 grams/milliliter (34.31 pounds/cubic foot). A one inch deposit of this material over one acre would weigh 62.3 tons. This sample had a fine texture and probably a lower density than coarser textured deposits closer to Mt. St. Helens. Other density values reported ranged from 0.4 grams to 0.7 grams/milliliter. One report from Ritzville stated that a heavy rainfall compressed the ash layer to 1/3 of its original thickness. Observers

at Waverly, Washington, calculated that an ash fall of just over 1 inch represented an application of 54.4 tons of ash/acre.

The size of particles in the ash varies considerably with greater proportions of coarser material in deposits closer to the volcano and in the earlier deposited ash. In the Pullman, Washington area 60 to 70% of the ash was reported to be in the silt size range (.002 to .05 millimeters) and most of the remainder was fine sand. A layer of this ash on the soil surface when compacted by water droplets from rain or irrigation could be expected to reduce water infiltration into the soil and enhance surface run-off and erosion.

An ash layer on the soil surface could have an appreciable effect on soil temperature. A light-colored ash, such as blanketed much of eastern Washington, would tend to reduce the absorbance of heat by tilled soil during warm sunny weather and could thus result in surface soil temperatures several degrees cooler than compared to soil with no ash. Also because of its porous nature, ash is a poor heat conductor. This could affect crop growth and result in a reduced growth rate, particularly of heat-loving crops such as tomatoes.

The unfavorable effects of the ash layer such as poor water infiltration and reduced soil temperature and dust can be reduced by incorporating the ash into the soil by disking or plowing.

In the hardest hit areas of eastern Washington, serious crop losses occurred when ash buried some crops such as wheat and alfalfa. Deep deposits of ash from several inches to several feet obviously result in crop destruction and severe reclamation problems.

Chemical Properties

The vast majority of the material in the volcanic ash does not dissolve readily in substances like water or weak acids and is therefore not chemically active when added to the soil. The ash has been subjected to three analyses:

1. Water-soluble elements are determined by extracting the ash with water. In this way, the amounts of elements which would be leached out of the ash by rain or irrigation or in lakes and rivers can be determined.
2. Analysis to evaluate elements, including plant nutrients in the ash which would be readily available to plants. The analysis is conducted by extracting the ash with a mild acid or salt solution.
3. Total analysis in which the ash is dissolved in strong reagents and the total amount of each of the elements in the ash is determined.

The results of chemical analyses conducted by laboratories in Oregon and Washington including Oregon and Washington State universities can be summarized as follows:

SOLUBLE SALTS: The soluble salt content of the fresh ash equalled 6.0 to 9.0 milli mhos/cm. This amount of soluble salt has caused leaf burn where ash has been deposited on dampened leaves or where light rainfall has dampened ash on leaves. Where significant amounts of rain or irrigation water wash ash from leaves, the salt is diluted and salt injury is thus reduced. The soluble salts consist mostly of the chlorides and sulfates of sodium, calcium and magnesium which are not toxic substances but rather have a fertilizer value as they are nutrients required in plant and animal growth. Ash samples which have been rained on contain much lower levels of soluble salt.

PLANT NUTRIENTS: By comparison with a fertile soil the volcanic ash contained the following levels of available plant nutrients:

High - sulfur, copper, iron, manganese
Moderate - boron
Moderate to low - potassium
Low - calcium, magnesium, phosphorus, zinc,
nitrogen

TOXIC ELEMENTS: Some elements are considered to be toxic to humans, animals, or plants if readily soluble levels are above certain concentrations. However, non-toxic concentrations of the following elements have been detected in extracts from the ash:

Aluminum, arsenic, boron, cadmium,
copper, fluorine, iron, lead, manganese,
and mercury.

ACIDITY (pH): The pH of the ash samples from Mt. St. Helens varied from 5.2 to 6.9 with an average slightly over 6.0. Lime requirement tests run on the ash indicate that it would not have an appreciable acidifying effect on soil.

TOTAL ANALYSIS: The volcanic ash consists largely of volcanic glass which is mainly composed of silica (SiO₂). The ash also contains feldspars and other minerals which are rich in silica and alumina (Al₂O₃) and also contain iron, calcium, sodium, magnesium, and potassium. These constituents are mostly insoluble and are found in ash deposited in the past by other Cascade volcanoes. Analytical data from Dr. Taylor's laboratory in the Geology Department at Oregon State University indicates that the Mt. St. Helens ash contained the following:

Silica 64, alumina 18, and oxides of
iron 4, calcium 4.8, sodium 4.8, magnesium 2,
and potassium 1.5.

The numbers indicate the percent of the substance in the ash.

Other Properties of Mt. St. Helens Ash

The particle size analysis of the ash shows that it is high in silt and sand and contains few clay size particles (less than .002 mm). This is reflected in a low cation exchange capacity of below 2 milli-equivalents/100 grams.

The water extracts contained fairly high levels of chloride which almost equalled 1000 ppm in some samples. Although this concentration

represents an undesirable high level, the chloride concentration would be rapidly reduced as rain and irrigation water leached the chloride into the soil resulting in dilution to a satisfactory level. One inch of ash would add about 100 pounds of chloride/acre whereas muriate of potash fertilizer applied at 200 pounds/acre would supply 96 pounds of chloride.

The ash is entirely mineral material and does not contain any organic matter. Significant additions of ash would therefore lower the concentration of organic matter in the surface soil.

June 12 Eruption

The June 12 eruption resulted in ash deposition in Oregon particularly in the Washington and Yamhill County area. This ash was coarser in texture and darker in color than much of the material deposited by the earlier eruptions. Rainfall accompanied ash deposition and the weight of wet ash on filbert leaves and wheat plants caused some physical damage. It was not possible to weigh an undisturbed sample of this ash due to the packing effect of the rain. Measurements on disturbed samples indicated that the dried ash weighed 79 pounds per cubic foot on which basis a one-inch deposit over an acre would weigh 143 tons. The leaching of soluble materials from the ash by the rain would reduce possible salt injury to plants.

We have not completed the chemical and physical analysis of samples of the ash. So far our analysis indicates that the ash is similar to the material from earlier eruptions. It is mildly acidic and contains low levels of plant-available potassium, calcium, magnesium, sodium, zinc and boron. The phosphorus content is somewhat higher than the earlier ash and by comparison with agricultural land would be in the moderate to low range. The available copper and manganese levels in the June 12 ash are considerably lower than in the earlier ash deposits. The copper levels were slightly lower in the ash than in the soil and manganese levels considerably lower than in the soil.

E. Hugh Gardner
Extension Soil Science Specialist
(503) 754-2441