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Testing hypotheses for the use of Icelandic volcanic ashes as low cost, natural fertilizers

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Andisols are soils derived from tephra/volcanic bedrock and are generally considered to be fertile for plant growth (cf. University of Hawaii at Manoa, CTAHR). However, few studies have been published examining the immediate effects of the addition of volcanic ash to soils immediately after an eruption. Our research is motivated by unpublished accounts from Icelandic farmers that the growing season following the 2010 Eyjafjallajökull eruption ended with unusually high yields in areas that were covered by ash from the eruption early in the spring. To test the hypothesis that addition of volcanic ash to soil would have no immediate effect on plant growth, we conducted a $\sim$6 week growth experiment in at controlled environment at the Dickinson College Farm. The experiment used relatively fast growing grain seeds as a test crop, controlled watering, known quantities of peat as an organic base, and the following general experimental design: peat was mixed in known but systematically differing proportions with 1) commercial quartz sand, 2) basaltic ash from the 2004 Grimsvötn eruption, and 3) trachyandesite ash from the 2010 Eyjafjallajökull eruption. For all experiments, the seeds growing in the simulated soil created with the two different composition volcanic ash had higher germination rates, higher growth rates, and produced plants that were healthier in appearance than the soil made from peat mixed with quartz sand. Some differences were also noted between the germination and grow rates between the basaltic and trachyandesitic ash experiments as well. Working hypotheses to explain these results include (1) shard shapes and vesicles from volcanic ash provide better water retention than quartz, allowing water to be stored longer and increasing average soil moisture, and (2) chemical nutrients from the ash facilitate germination and growth of plants. Documenting the potential benefits of fresh volcanic ash as a fertilizer is important as use of fresh ash fertlizer could lower the cost of raising crops in countries disrupted by explosive volcanic eruptions and turn a short-term negative associated with volcanic eruptions (ash fall) into a societal benefit (local source of inexpensive fertilizer). However, long term studies are also important to document how changes to ash during pedogenesis might affect long term soil structure and fertility.