Pit Disposal of Cull Onions

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Onion production in the Treasure Valley region of eastern Oregon and southwestern Idaho comprises approximately one-third of the total annual U.S. storage onion crop and constitutes a regional farm value between $70 and $90 million per year. Onions are harvested from August through October. Generally, onions produced in the Treasure Valley are marketed from harvest through April and constitute about 50 percent of the total U.S. fresh onion market during this period.

The large quantity of onions produced in the Treasure Valley, combined with stringent industry inspection standards, create a substantial quantity of culls. Cull onions are a result of the grading process or breakdown in storage, as well as bulbs and waste left over from seed production (Idaho State Department of Agriculture, IDAPA 02.06.17). Cullage rates resulting from onions not meeting size, shape, and quality standards during grading are generally lowest during harvest but increase thereafter from storage-related decay.

Each year, the onion industry needs to safely dispose of 40,000 to 100,000 tons of cull onions. Primary disposal methods available to onion growers and storage-facility operators include land application, feeding to livestock, and burial. The proportion of cull onions that is applied to land and fed to livestock is limited (generally less than 40 percent), due to transportation costs and livestock availability.

The most common disposal method for cull onions is to bury them in unlined, covered pits or landfills (Figure 1). This management practice provides an inexpensive alternative for discarding the large quantity of storage onion culls. Proper cull onion disposal is required to control insects and diseases, and it is an essential component of an integrated pest management program to control onion maggot. Additionally, safe disposal methods should be utilized to prevent offensive odors and to protect the environment. Regardless of disposal method, cull onions must be buried or covered with onion-free soil by March 15 as specified by the Idaho State Department of Agriculture (IDAPA 02.06.17).

Contamination of groundwater from agricultural sources is a major health concern in the Treasure Valley. In this area, water quality in 89 percent of shallow wells is impacted by nitrate (NO_3-N >2 mg/L), and 4 percent of all wells exceed the drinking water standard for nitrate (NO_3-N>10mg/L) (Neely and Crockett, 1998). Soil samples from a retired cull onion disposal site near Weiser, Idaho, indicated that pit disposal of cull onions concentrates substantial quantities of N (greater than 3,000 ppm ammonium-N), and could pose a potential environmental hazard through nitrate leaching if not properly managed. In a five-year study of two full-scale cull onion landfills, researchers at the University of Idaho College of Agriculture determined that the disposal method was environmentally

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Figure 1. The most common method for cull onions is to bury them in unlined, covered pits or landfills.

safe when using proper management practices (Hutchings et al., 1998). In this bulletin, we will summarize the experimental findings of this study and recommend environmentally sound management practices for disposal of cull onions in burial pits or landfills.

Experimental Findings

Onions contain approximately 2 percent N on a dry-weight basis and are about 90 percent water by weight. Substantial quantities of N and water are introduced into burial pits as part of onion cullage. However, less than 0.01 percent of the total N in onions is in the mobile nitrate (NO_3-N) form at the time the onions are placed in the pits.

In this study, elevated nitrate concentrations only occurred in and below disposal pits during loading (Figure 2). Following closure of the burial pits with a soil cover, nitrate concentrations within burial pits and in the soil solution below the pits decreased to negligible levels. In contrast, ammonium-N (NH_4-N) concentrations increase dramatically in the cull onion landfills following closure (Figure 2). Ammonium-N concentrations in the pits increase to maximum levels (about 400-500 mg/L) during the first two years following closure, then stabilize and remain constant. Ammonium also increases in the first two feet of soil region below the base of the pits, but does not increase substantially at deeper depths.

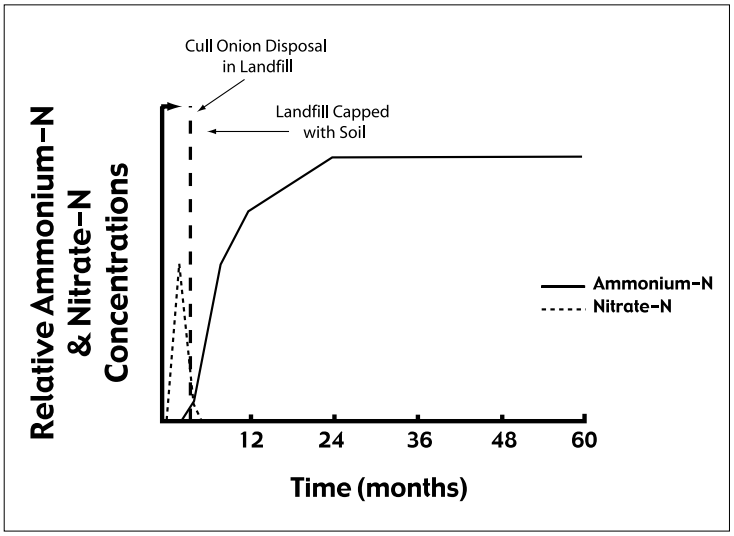

Figure 2. Relative concentrations of ammonium-N and nitrate-N in a cull onion landfill during loading and following closure with a soil cap.

During onion degradation, water levels increase in the cull onion landfills or burial pits even though the soil permeability of pit bases may be adequate to allow for complete drainage of water. Restricted downward percolation is common in systems involving organic wastes such as cattle feedlots and dairy lagoons because soil pores become clogged with organic waste and limit drainage; essentially, lagoons and feedlots act as self-lining systems. Organic self-lining of animal waste lagoon systems typically reduces soil permeability by two to three orders of magnitude. Engineering applications of this process, called artificial gleization, is used in construction of ponds and lagoons to prevent excessive water losses (see Soil Conservation Service, 1979; Soil Conservation Service, 1990). The continued presence of standing water in the cull onion burial pits for several years following capping indicates that they also self-seal during degradation of the onions. This process restricts deep percolation and, consequently, any substantial leaching of nitrogen compounds from the cull onion disposal pits.

Nitrate levels in and beneath cull onion pits fall to zero in less than three months following capping. This occurs because the oxygen content and flow are limited in the saturated, soil-capped systems. The low oxygen (anaerobic) environment inhibits the formation of nitrate from ammonium (nitrification) and stimulates the conversion of nitrate to gaseous forms of N (denitrification). Similar inhibition of nitrate production occurs in cattle feedlots and dairy lagoons that contain N-rich organic material.

The conversion of organic N in the onions to ammonium (mineralization) is not impeded by anaerobic conditions; consequently, ammonium increases in saturated pits (low oxygen conditions) where organic N materials are available. The pool of organic N, deposited in the pits as cull onions, converts to ammonium-N following closure in the low oxygen environment (Figure 2). Ammonium does not leach readily from cull onion burial pits because it is a cation and strongly adsorbs to degraded organic material within the pits and to soil materials underlying the pits.

In summary, the water-saturated, low oxygen conditions that develop within cull onion burial pits following capping limit the formation of nitrate, a highly mobile N form, in disposal pits and promote the formation of ammonium, a less mobile N form, during the first several years following closure. Loss of N to the environment via nitrate leaching from cull onion burial pits does not occur as long as anaerobic conditions are maintained through proper closure and maintenance of the pits.

Recommended Management Practices

The Idaho State Department of Agriculture (ISDA) has established rules and guidelines for the proper disposal of cull onions (see Idaho Administrative Procedures Act, IDAPA 02.06.17). A copy of the cull onion disposal rules can be obtained from the Idaho State Department of Agriculture or from the ISDA Homepage www.state.id.us/adm/adminrules/rules/idapa02/02index.htm on the Internet.

Pit or landfill disposal of cull onions does not pose a significant environmental threat if the pit site is suitably located, is well-constructed, and is loaded and maintained properly. To minimize environmental, disease, and odor problems associated with cull-onion disposal using landfill or burial pits, the following recommendations should be followed:

1 Disposal Site Selection - Landfills or burial pits used for cull onion disposal should be established in areas where disposal operations will not pose an odor nuisance to people living adjacent to the site. The site should be in an area where the water table is sufficiently deep (depths of 100 feet or deeper) to avoid groundwater seepage into the pit during operation and to minimize ammonium-N, nitrate-N, odors, or any undesirable substance associated with rotting onions from entering the groundwater supply. Idaho law requires that permission for burial pit operation be obtained from county officials. Additionally, local district health officials, the Idaho Division of Environmental Quality, and the Idaho Department of Agriculture should be consulted before developing a burial pit disposal site to avoid violation of applicable environmental and agricultural regulations.

Figure 3. Filling of the pit should begin at one end in order to facilitate coverage with soil during loading.

2 Burial Pit Development - The landfill or burial pit should be excavated at the required dimensions to facilitate disposal of culls generated during the shipping and processing season. Dimensions of currently operating burial pits are approximately 300 feet in length, 30 feet in width, and 15 feet in depth. Burial pits could have smaller dimensions if less cullage is generated, but the depth should always exceed 10 feet; this depth will allow a sufficiently thick soil cover after settling (approximately 6 feet) to prevent the development of adequate oxygen conditions for nitrate formation. Soil removed during excavation should be piled along the sides of the pit for capping and leveling purposes. Ditches or berms should be constructed around the pit to prevent water runoff from accumulating in the pit during loading or on the capped pit while it settles.

3 Loading and Disposal of Cull Onions in Pits - A burial pit can be loaded (filled) in a single layer of cull onions with a soil cap or in alternate layers of onions and soil. Filling of the pit with onions should begin at one end to facilitate coverage with soil during loading (Figure 3). To minimize the release of nitrate during disposal, loading and capping should be done in a timely manner to decrease the period in which the pits are aerobic. A layer of soil should be placed over the onions as the desired depth or layer thickness of cull onions is achieved. A soil layer placed over the disposed onions will limit undesirable odors and prevent development of aerobic conditions (adequate oxygen) which may promote the conversion of organic N and/or ammonium-N to nitrate-N. A compacted soil cap, with a minimal thickness of two feet, should be established over the pit immediately after loading is completed. Regardless of the loading operation, cull onions must be capped by March 15 to minimize insect and disease problems according to Idaho State Department of Agriculture rules (IDAPA 02.06.17).

4 Burial Pit Maintenance After Loading - The soil caps should be actively maintained during the course of pit operation and pit closure to avoid excess recharge by surface water. As cull onions degrade, the burial pit surface will settle. Settling will occur for three to five years,

depending on the quantity of onions disposed and pit volume. Soil accumulated during pit excavation and stored along pit boundaries can be used to maintain the pit surface. The soil cap should be mounded slightly above grade to prevent water accumulation from runoff or precipitation. A properly capped burial pit along with a drainage system around the pit boundaries will provide the control necessary to prevent excess water accumulation.

5 Burial Pit Closure - After the pit has finished settling, the soil surface should be leveled or left slightly mounded. To prevent blowing dust and soil erosion, the surface of the pit and the surrounding area should be seeded with cover vegetation. The area should be prepared to provide the best possible soil conditions for seeding. Successful revegetation of the disposal site depends on the climate, the fertility status of the disturbed soil, and the adaptability of the selected plant species. Contact the local NRCS or district conservation offices for recommended grasses or natural vegetation and revegetation techniques for the geographical location of the disposal site. For more information on choosing suitable cover plant species and various revegetation techniques for disturbed soil surfaces, see USDA-NRCS Agricultural Handbook 339 and USDA Bulletin SCS-TP-157.

6 Burial Pit Reuse - A continuing concern where N-wastes are concentrated is the potential for nitrification to occur in the future if suitable conditions develop. To mitigate the threat of long-term NO_3 leaching and to allow for recycling of existing pits, it is recommended that residual wastes be removed from pits when dry, a process that takes about 5 years with proper maintenance. The dried waste can then be applied to fields or pastures at acceptable agronomic N-loading rates. This would decrease the land area required for disposal, reduce costs associated with excavating new pits, and substantially alleviate future environmental problems associated with burial pit disposal of cull onions. To determine the appropriate land application rate, the residual wastes should be analyzed for N content and applied to the soil accordingly. Further information on soil testing and revegetation can be obtained from the University of Idaho Cooperative Extension Service.
See http://info.ag.uidaho.edu for the on-line catalog.

Further Reading

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