University of Idaho
College of Agriculture
Cooperative Extension System

CIS 814

Cull and Waste Potato Management

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INTRODUCTION

Potatoes unusable for fresh market, processing, or dehydration because they do not meet minimum size, grade, or quality standards, or potatoes disposed of because of low market value due to overproduction, are considered waste, or "cull," potatoes. Cull potatoes may accumulate any time during the year, but several periods are especially critical. At planting, potato waste material may accumulate when seed pieces or tubers are discarded due to size (slivers) or disease problems. At harvest, potatoes that do not make grade due to size, disease, or defects are sorted out and discarded prior to placement of the crop into storage. Any time potatoes are removed from storage, those that are diseased, damaged, out of grade, or in oversupply are once again culled and discarded.

The accumulation of cull potatoes also occurs year-round at fresh pack and processing operations. Because cull potatoes are constantly being produced for a variety of reasons and at many different locations throughout the state, dealing with proper disposal can be difficult, especially in years when cull potatoes are particularly abundant.

Managing cull potatoes and associated dirt and plant debris needs to be incorporated into the normal management routines of growers, fresh packers, and processors. Allowing cull potatoes to accumulate without proper disposal practices can have undesirable consequences, which include the following: (1) cull potatoes can be a source of late blight inoculum, leaf roll virus, and other diseases that can spread to your own fields and neighboring fields; (2) rotting cull potatoes produce odors and attract insects that neighbors and other growers would deem unacceptable, and (3) decomposing potato piles provide a point source for nutrient leaching to ground and surface waters.

Disease, insect, and weed concerns

Cull potatoes are excellent hosts for potato diseases and can provide a safe haven for potato insects to increase in numbers. Important pests that can be harbored in waste potatoes include late blight, potato leaf roll virus (PLRV), bacterial ring rot, and nematodes. Soil associated with cull potatoes can be infested with pests such as powdery scab, nematodes, and weed seeds. Waste potatoes must be handled correctly to eliminate these and other potential dangers.

Since the recent outbreaks of late blight in the Northwest's potato-growing regions, cull potato and debris management has become a vital part of any management strategy. Late blight can originate in infected cull potatoes through the production of infected tuber sprouts or the disease can simply sporulate on infected tubers. Late blight could also infect unprotected foliage produced by healthy cull potatoes. Spores produced from any of these infections are readily wind disseminated and could initiate a regional epidemic.

When discarded potato tubers sprout, their unprotected foliage can also become a breeding ground for insects such as aphids and potato beetles. Green peach aphid, an excellent vector for PLRV, can thrive on the unprotected foliage of cull potatoes and spread from there to noninfested fields. If the cull potatoes themselves are infected with PLRV, the vector may well acquire the virus and immediately spread it to uninfected plants in adjacent potato fields. Spread of bacterial soft rot by flies visiting decaying potatoes has also been demonstrated.

Ground and surface water contamination and nuisance situations

Cull potatoes can provide a significant supply of nutrients, so locations where either ground or surface water contamination can occur need to be avoided. To prevent potential surface water contamination, do not dispose of cull potatoes near point water sources such as irrigation ditches, springs, ponds, lakes, and streams. A decomposing pile of potatoes can also be a significant nuisance due to its offensive odors and the inevitable presence of flies and other undesirable insects. Be sure to select a disposal site and method that will not allow disposed potatoes to become a public nuisance.

OPTIONS FOR CULL POTATO MANAGEMENT

In addition to disease and insect pests, water contamination, and offensive odors, serious issues to consider include the cost of disposal, potential for volunteer plants, land availability, and amount of cull or waste potatoes. The most feasible method for disposal will depend on the individual situation (location, amount of potatoes, etc.) as well as the time of year. Disposal during the months of the year when waste potatoes can be reliably expected to freeze can greatly simplify the process, while disposal during the warmer months can greatly add to the challenge of proper disposal.

Winter field spreading

One very good option for disposing of cull potatoes is to spread them on top of the soil on land that will not be used for potato production. Avoiding fields that will be planted to potatoes is important because cull potatoes can introduce nematodes, weed seeds, and other soilborne diseases to the field. Field spreading may not be the best option in very late winter, spring, or summer when temperatures are too warm to freeze potatoes. In general, potatoes must be exposed to temperatures of 28°F for at least 24 hours in order to completely freeze.

Weather conditions during the winter will also allow the potatoes to substantially desiccate, which will make spring field tillage easier. Avoid tilling the field until cull potatoes have had substantial time to freeze and desiccate. Premature tilling could bury live tubers deep enough into the soil to insulate them from further exposure to killing temperatures. These inadequately frozen potatoes could emerge as volunteer plants later in the spring and become a source of disease and insect problems.

It is extremely important not to pile waste potatoes too high during field disposal. This practice will often serve merely to insulate the potatoes underneath from freezing. Spread cull potatoes on top of the soil surface no more than two potato layers deep (approximately 6 inches). Shredding the potatoes with a silage or forage chopper prior to land application can decrease the chances of potatoes producing new growth. Chopping cull potatoes into smaller pieces makes the tuber tissue more susceptible to rot and desiccation, which is desirable.

Fields where spreading occurs must be monitored in the spring for volunteers. If some plants escape adverse winter temperatures, manage the volunteers with appropriate herbicides or tillage. For current recommendations regarding selecting herbicides for volunteer control, contact the extension educator in your county or refer to University of Idaho CIS 1048, *Volunteer Potato Control*. Cultivating the field may also help keep volunteer potatoes in check. Avoiding regrowth and sprouting of the potatoes is the key to success in this method of cull management.

Fertilizer Benefits of Cull Potatoes. Cull potatoes are a significant fertilizer source that needs to be accounted for when calculating the fertility requirements of the crop following cull potato application. Fields that will be planted into grain or forage are particularly good candidates for using cull potatoes as a partial fertilizer source.

Table 1 contains generalized information on the nutrients cull potatoes might be expected to contribute to a following crop. There are limits to how many potatoes can be applied, however, which in turn limits how many pounds of nutrients will be available. To ensure proper decomposition, remember that cull potatoes should not be piled more than about 6 inches deep.

Fertilizer inputs and costs can be reduced by incorporating cull potatoes into the soil during field preparation in the spring. Given the nutrient amounts that field-applied cull potatoes are expected to provide, it is possible to estimate the dollar value of their fertilizer benefit. Table 2 provides estimated dollar values of field-applied cull potatoes compared with costs for commercial fertilizers. At the prices listed, applying 100 cwt (10,000 pounds) of potatoes per acre would provide $10.99 worth of nutrients. Costs for commercial fertilizers vary each year, so current prices should be taken into account when preparing estimates.

Table 1. Generalized nutrient composition and content of cull potatoes.

Nutrient	Dry weight	Fresh weight nutrient content[1]	
	(%)	(lb/100 cwt)	(lb/ton)
Nitrogen	2.14	43.0	8.6
Phosphorus	0.29	6.0	1.2
Potassium	2.40	48.0	9.6
Calcium	0.074	1.48	0.296
Magnesium	0.148	2.96	0.592
Sodium	0.029	0.58	0.116
Manganese	0.0007	0.01	0.003
Iron	0.0132	0.26	0.053
Zinc	0.0018	0.04	0.007
Copper	0.0010	0.02	0.004
Boron	0.0006	0.01	0.002

[1]Based on 80% potato moisture content.

Source: Painter, C.G. 1979. Nutrient use by potato vines and tubers. CIS 470. Moscow, Idaho: University of Idaho Cooperative Extension System and Idaho Agricultural Experiment Station.

Table 2. Estimated costs of commercial fertilizers and return value of nutrients supplied by field applications of cull potatoes.

Nutrient	Estimated cost per ton of commercial fertilizer ($)	Estimated cost per pound of commercial fertilizer ($)	Estimated value of fertilizer in 5 tons or 100 cwt of potatoes[1] ($)
Nitrogen (46%)	255.00	0.13	5.59
Phosphorus (52%)	260.00	0.13	0.78
Potassium (60%)	170.00	0.09	4.32
Magnesium		0.08	0.24
Zinc		0.75	0.03
Copper		0.85	0.02
Boron		0.45	0.01
Total			$10.99

[1]Based on table 1, fertilizer content (lb) of nutrient per 100 cwt fresh tuber weight.

Burial

Burying cull potatoes is a viable disposal method anytime during the year. This is an especially good option when winter weather is no longer severe enough to freeze and desiccate the cull potatoes.

For this disposal method, large trenches are excavated in a location with a low water table and away from any water source. Trenches must be large enough to accommodate not only the cull potatoes but also at least 18 inches of soil to be placed over the top of the pile. More soil may need to be added for coverage if sprouts begin to emerge. When covering the potatoes with soil, avoid using tare dirt or other sources that may contain small pieces or slivers of potato tubers.

Ideally, trench filling would alternate layers of potatoes and layers of soil. Layering will facilitate the breakdown of the buried potatoes. Mound soil over the pile so that surface water is diverted away from the site. Additional soil may also need to be added to the top as the buried potatoes begin to settle.

Table 3. Average nutrient values of potatoes and barley for livestock feed.

	Potatoes	Barley
Dry matter	23%	88%
Crude fiber	2.5%	5.6%
Ether extract (fat)	0.4%	2.2%
Crude protein	9.5%	13.9%
Digestible protein	5.9%	10.9%
TDN	81%	82%
Metabolizable energy	2.93/kg	2.99/kg
Net energy maintenance	1.91/kg	1.96/kg
Net energy growth	1.27/kg	1.31/kg
Net energy lactation	1.87/kg	1.91/kg
Calcium	0.04%	0.05%
Phosphorus	0.24%	0.37%

Source: Ensminger, M.E., and C.G. Olentine, Jr. 1978. Feeds & nutrition–complete. Clovis, California: The Ensminger Publishing Company.

Livestock feed

Cull potatoes are high in food value and easily digestible, which makes them excellent feed for beef and dairy cattle (table 3). Incorporating cull potatoes into a livestock ration can be both an economical disposal method and a good source of a feeding supplement. Cull potatoes can substitute for barley feed at a ratio of 4.5 pounds (wet weight) of potatoes per 1 pound of grain. Cull potatoes may be used to replace up to 50 percent of the grain needed for finishing steers, while dairy cattle rations should not have more than 20 to 25 percent of the normal concentrate replaced with potatoes.

Potatoes as a feed source differ from other sources in several important ways. Cull potatoes have much less fiber than most grains; therefore, it is necessary to introduce potatoes into the animal's diet gradually. Begin by adding 2 to 3 pounds of potatoes per day to the animal's diet and increase the amount in the ration by 2 to 3 pounds per day until reaching the desired level. This lower fiber level is especially important in dairy rations because low fiber levels can depress butterfat production in lactating cows.

Potatoes also have a relatively low dry matter content; therefore, total dry matter intake may decline, especially if potatoes are used with other high-moisture feeds such as silage. Protein nutrition is another factor. The protein found in potatoes is considered low in digestibility, potentially as low as 60 percent, because much of the protein is in the form of nonprotein nitrogen. For this reason, feeding potatoes to mature animals that can utilize nonprotein nitrogen more efficiently is better than feeding them to calves.

Feeding fresh cull potatoes to livestock may provide the best results. Cull potatoes fed to livestock should be reasonably clean and free from dirt. Some producers prefer to wash the tubers before feeding, while others have had good success feeding potatoes directly from storage.

Stockpiling or storing potatoes can result in reduced palatability and potentially dangerous toxin development if potatoes spoil or turn green. If storage is necessary, ensiling the potatoes may be the best option. Chopping and mixing 100 pounds of potatoes with 20 to 25 pounds of straw, dry hay, or chaff will produce a desirable product. Other methods of ensiling include mixing 500 pounds of chopped potatoes with 1 ton of corn silage.

There are risks associated with feeding cull potatoes to livestock. Choking and poisoning are two primary concerns, with choking posing the greater risk. Potatoes can be chopped or crushed to reduce the risk of choking, but proper feeding management can also reduce the risk of choking to the degree that chopping or crushing may be unnecessary. Try to keep the cows' heads down when feeding cull potatoes to lessen the likelihood of choking. If bunk feeding potatoes to cattle, use a rail or hot wire 2 to 3 feet above the bunk to keep the cattle's heads down. When feeding on the ground, feed in large quantities so there is no competition among the animals. This practice will prevent the animals from gulping the potatoes. Softened or flaccid potatoes are also desirable.

Poisoning of animals being fed cull potatoes comes primarily from toxic glycoalkaloids that develop in potatoes under certain conditions. These compounds can accumulate in potatoes that are green or sunburned due to exposure to light and in sprouted potatoes. Poisoning generally occurs when high concentrations of sunburned, green, or sprouted potatoes are included in the ration. Symptoms of glycoalkaloid toxicity include staring eyes, dilated pupils, trembling, staggering, weakness, and, occasionally, convulsions. If these symptoms occur, remove the cull potatoes from the ration immediately.

Feeding cull potatoes to livestock is an option as long as both feeding and manure disposal are accomplished on nonpotato ground. Pieces of potato not fully digested by the cow can be discarded on the soil, and since the potato pieces are still intact, there is a potential for nematode and disease survival. There are also several potato diseases, such as powdery scab, that can survive the digestive process even if the potatoes are fully utilized.

Compost

Cull potatoes can be composted, but the procedure must be done properly. An improperly managed compost pile is merely a cull pile in disguise. Care and management are needed to make this a viable disposal option. Proper composting requires adequate temperatures, air circulation, moisture, and suitable carbon to nitrogen ratios.

Proper compost pile temperatures are vital. Recent research by Dr. William Kirk at Michigan State University demonstrated that a temperature of approximately 113°F was required to kill late blight disease. Much higher compost pile temperatures are both possible and desirable. Typically, temperatures need to be 120° to 155°F to be most effective. Aeration is also very important because many microorganisms involved in the decomposition process require oxygen, a requirement met by frequent and consistent turning of the pile. In general, the more the pile is turned and aerated, the faster the decomposition rate will be.

Some moisture is required, and generally compost piles need about 40 to 60 percent moisture content by weight. Potatoes contain about 80 percent moisture, so typically additional water is not needed. In fact, due to the high levels of moisture in potatoes, conditions may become so wet that the pile becomes anaerobic and foul smelling and will not compost correctly if not managed properly.

The equipment necessary to manage compost potato piles will depend upon the amount of material being composted. To ensure proper decomposition, the carbon to nitrogen ratio (C:N) within the pile needs to be approximately 20:1. Therefore, other materials need to be incorporated into the compost process, such as straw, sawdust, manure, or other plant residue. Shredding the potatoes prior to composting will provide more efficient composting.

In summary, composting potatoes is a possible means for disposing of cull potatoes, but because the process involves careful management and monitoring, this option may not be the best for many growers, especially those with large amounts of waste potatoes. If composting cull potatoes is a desired disposal method, contact the extension educator in your county for more information.

MONITORING PILE SITES

Cull piles and areas where cull piles have been disposed need to be carefully monitored to ensure no detrimental environmental effects. Rotting potatoes are a potential source of odors and readily attract a variety of undesirable pests. The problem is greatly magnified when air temperatures begin to warm. The potentials for environmental damage and for nuisance problems are very good reasons to select your disposal sites carefully.

Cull potato piles that have accumulated over the winter months may or may not sprout the following spring, but still need to be monitored. The dynamics of cull piles have actually been studied in some detail, and there are several factors to keep in mind. Potatoes on the outside surfaces of a cull pile will most likely freeze and die during the winter months. In contrast, potatoes in the center of the pile usually suffer from a lack of oxygen and will succumb to bacterial soft rot, a process that also generates heat.

In between these extremes is a zone where potatoes may escape both freezing and rotting. Depending on outside air temperatures, potatoes at some distance below the surface are insulated from both outside and internal influences and can survive even the coldest winter conditions.

The zone where potatoes may survive depends on the duration of low air temperatures and the size and depth of the pile. Research at Michigan State has demonstrated that potatoes below the surface of the pile rarely get below 32°F. Generally, potatoes will die after 24 hours at 28°F or 12 hours at 25°F. Naturally, the deeper and wider the cull pile, the larger the survival zone and the greater the likelihood that some of the cull potatoes will still be able to sprout in the spring.

Herbicides can be used in sprouting cull piles, but there are currently no herbicides capable of eliminating all emerging sprouts. Several applications of herbicide may be necessary in some cases. Some herbicides may malform or destroy the foliage, allowing the tuber to resprout. As always, when treating cull piles with herbicides, avoid drift onto cropped fields due to the potentials for immediate or long-term crop damage.

SUMMARY

- Cull potatoes are an excellent source of disease and insect problems.
- Select a disposal site and method that will not allow disposed potatoes to become a public nuisance.
- Determine if your method of disposal or cull pile is a source for ground or surface water contamination and avoid this potential problem.
- Dispose of cull potatoes on a regular basis to avoid dealing with large quantities of waste potatoes.
- Select the best disposal option based upon time of year, amount needing disposal, proximity to cattle or dairy feeding operations, and availability of nonpotato cropped land.
- Monitor all cull disposal sites for volunteer potatoes. Cover, cultivate, or apply appropriate herbicides as needed.

STATE REGULATION IDAPA 02.06.17

The Idaho State Department of Agriculture requires cull potatoes from all potato operations to be rendered nonviable on a daily basis after April 15th in the Magic and Treasure valleys (west of Raft River) and after May 15th in the upper Snake River valley of eastern Idaho (east of Raft River). This regulation continues through September 20th and is in place to help eliminate a potential source of problems for the current season crop and to aid in maintaining the integrity of Idaho's potato crop production and quality. Cull disposal must be accomplished in an environmentally safe, legal, and effective way. For further information, contact the Idaho State Department of Agriculture, Idaho Division of Environmental Quality, or your local district health department office.

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Issued in furtherance of cooperative Extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, LeRoy D. Luft, Director of Cooperative Extension System, University of Idaho, Moscow, Idaho 83844.

Published 1987, Revised May 2001 $1.00