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Volunteer Potato Management
in the Pacific Northwest Rotational Crops

Volunteer potatoes (*Solanum tuberosum*) are a prevalent weed in the Pacific Northwest (PNW) and other potato production areas of the world. Field surveys have shown that 25,600 to 186,155 tubers per acre are left in the soil following a commercial potato harvest. In areas where winter soil temperatures are not cold enough to kill tubers left in the field, serious weed problems occur. In the PNW, volunteer potatoes are a problem in cultivated crops such as alfalfa, beans, carrots, corn, onions, peas, potatoes, and wheat. They are especially damaging in non-competitive crops with few effective management options. In addition to being a competitive weed, volunteer potatoes harbor insect pests, nematodes, and disease, which partially negates the benefit of crop rotation. Volunteers may also contaminate potato seed production fields, rendering them useless as seed.

While measures have been developed to help manage volunteer potato populations, no single method has been shown to be capable of reducing volunteer populations to non-competitive levels. It is best to integrate many measures and use a holistic approach for volunteer potato management.

This bulletin is intended to provide current information for volunteer potato management in the PNW. It will discuss the biology and ecology of the weed, its burden to production systems, and potential management strategies.

THE IMPORTANCE OF MANAGEMENT

Crop Competition

Volunteer potatoes are very competitive in rotational crops. They compete for light energy, nutrients, and water. In a study conducted at Paterson, Washington, volunteer potatoes reduced corn yield by 23 to 62 percent. Yield loss in onions and carrots has been estimated as high as 90 percent. Volunteer potatoes have also been shown to reduce yield in beans, sugar beets, and legumes. Yield losses also occur in more competitive crops such as mint, wheat, and alfalfa. Soil tuber density can increase over the course of the season if volunteer plants are not controlled (Figure 1). Volunteer potatoes complicate harvest operations and reduce the quality of several crops. Volunteer potato berries may be roughly the same color, size, and density of processed peas, which reduces their quality or adds to the expense of separating them. More specific information on losses due to volunteer potatoes will be discussed in the Management Options section of this bulletin.

Figure 1: This carrot crop will be unable to reach its full yield potential because of overwhelming competition (Thorton & Newberry).

Diseases and Pests

To produce a high yielding, high quality crop, commercial potato producers must manage diseases, viruses, insects, and nematodes. Volunteer potatoes harbor diseases, insects, and nematodes that potentially increase the severity of these pests in future potato crops. Moreover, volunteer potatoes can serve as a primary source for disease and insects in adjacent fields, adding to the damage and management costs in commercial production fields.

Volunteer potatoes can be a reservoir for late blight during the growing season. Late blight on volunteer potatoes may be untreatable due to the fact that effective fungicides are not labeled for use in the crop they infest. Research in the 1990s found volunteer potatoes to be the main overwintering host and the primary inoculum source for most potato viruses in Washington State. Volunteer potatoes play a major role in the survival of potato leaf roll virus (PLRV) and potato virus Y (PVY). By hosting these viruses, volunteer potatoes enable them to survive, multiply, and be transmitted to commercial potato crops. Infected volunteer potatoes in rotation crops and commercial potato fields can be a catastrophic source of PLRV. The green peach aphid (*Myzus persicae*) is an insect pest and the primary vector of PLRV to susceptible varieties in seed and commercial production areas. Volunteer potatoes infected with PLRV in rotational crops are a source of inoculum in neighboring clean potato fields. Green peach aphids will vector the virus from the infected volunteer potato to the neighboring commercial field, resulting in unacceptable levels of net necrosis in the tubers and possible rejection of the entire field by the processor. PLRV in seed potato fields may disqualify them from certification and therefore create unusable seed. Tubers generated from volunteer potatoes can host tobacco rattle virus, which is transmitted to potatoes by stubby root nematodes and causes corky ringspot disease.

Other pests may use volunteer potatoes to persist through a crop rotation. In Europe, plant parasitic nematodes such as the potato cyst nematode have been shown to multiply rather than decline in fields infested with volunteer potatoes. When growing a rotation crop free from volunteer potatoes, growers can experience a 35 percent reduction in nematode populations.

Although seen as a potential benefit in reducing tuber numbers and vigor of volunteer potatoes, insects such as the Colorado potato beetle can build up tremendous populations on volunteer plants. Research in the Columbia Basin has shown that volunteer plants are the first food source to emerge in the spring and serve as the host for early emerging adult beetles. Although beetle defoliation of volunteers can be seen as a benefit, once the plants are defoliated, they may move on to nearby commercial fields and solanaceous weeds, allowing a more vigorous second generation to develop.

The increase and persistence of disease, insects, and nematodes from the presence of volunteer potatoes are well documented and can be a detriment to the benefits of crop rotation. Thus, management costs will be returned not only in the rotational crop, but also in adjacent potato fields and when the infested field is returned to potatoes.

Contamination

Another problem with volunteer potatoes is the potential to contaminate rotation crops, which may severely reduce that crop's quality and value. Peas grown for canning or freezing must produce a continuous supply of clean raw product to the processor at harvest. Potato foliage and berries can contaminate the raw product and are very difficult to remove. Additionally, the presence of the toxic glycoalkaloids in volunteer potato foliage and berries may render an infested pea crop useless.

Commercial seed potatoes are also affected by volunteer potatoes. Each state seed certification agency has its own quality standards for uniformity. Contamination by volunteers can result in mixed varieties being planted within the commercial crop. In addition to the problems with volunteer plants derived from tubers, volunteer potato populations can also be sustained and created in potato fields from true seed. In Europe, true seed potatoes persist for many years in potato fields.

BIOLOGY OF THE VOLUNTEER POTATO

Potatoes (*Solanum tuberosum*) are a perennial plant that can be established through vegetative propagation via tubers or from seed. Within U.S. production systems, volunteer potato plants almost exclusively originate from tubers rather than true seed.

Persistence in Soil and Overwinter Survival

In the PNW, potato harvest operations are the primary source of volunteer potato seed tubers in the soil. Tubers remaining in the field after harvest vary in size. In a survey of potato fields in the Columbia Basin the number of tuber leavings ranged from 7.6 to 126 cwt per acre (Newberry and Thornton). The majority of the tubers remaining in the soil were small, most weighing less than one ounce. Many factors were found to influence the size range and depth placement of the tubers, such as the use of preharvest vine desiccation. Harvest from dead (desiccated) vines left fewer, smaller tubers in the field after harvest. Green (non-desiccated) vines tended to carry tubers of larger size and quantity off of the harvester, resulting in larger tubers remaining in the field at or near the soil surface (Newberry and Thornton).

Following harvest, greater than 90 percent of remaining tubers are found within eight inches of the soil surface (Figure 2). In a Columbia Basin survey, 65 percent of tubers remaining after harvest were on the surface or in the top four inches of the soil (Newberry and Thornton). The remaining 35 percent located below four inches can total 25,742 tubers per acre, which is greater than a standard commercial planting (12,800 to 19,200 seed pieces/acre). Because of the protective soil covering, these tubers are rarely exposed to temperatures that are low enough to render them non-viable. The large range of tuber depth placement means varying emergence times for volunteer potatoes in the spring.

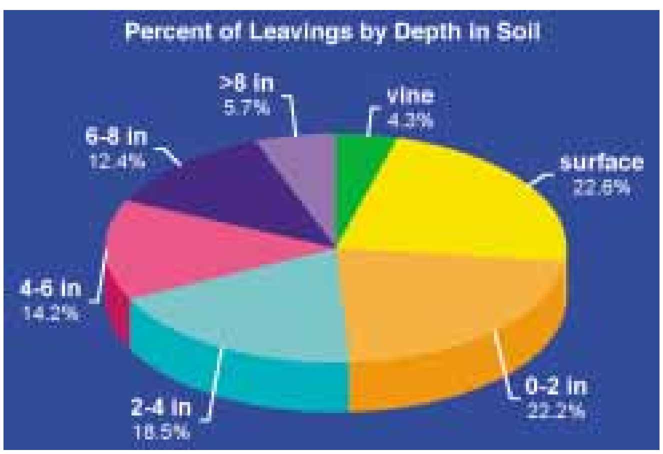

Figure 2: The percent of tubers remaining in the soil after harvest declines by depth in soil (Newberry and Thornton).

Winter survival of volunteer potato is reduced by damage done from frost, birds, pests, disease, and physical harm from cultivation. In most of the PNW, temperatures do not remain cold enough for a sufficiently long period to kill all tubers left in the soil after harvest. In the Columbia Basin, tubers need to be exposed to temperatures of 28°F or lower to be rendered nonviable (Boydston and Seymour). A study from the Netherlands reported that tubers need to accumulate 50 frost hours below 28°F in order to be killed. Frost periods frequently kill tubers remaining in the upper layers of the soil in the PNW, but fail to affect more deeply buried tubers. In Othello, Washington, frost kills tubers below four inches only about one in four years (Thornton). Even when frost can be counted on to kill tubers in the top four inches of the soil, approximately 19,123 tubers/acre still remain after harvest, a population high enough to cause great concern. Deep penetrating cold winter temperatures can result in complete control of volunteer potatoes with no effort or expense by the grower.

In spite of occasional cold winter temperatures and rotation crop competition, volunteer potatoes have been documented to regenerate for as long as 20 years. The first year after potato production normally has the greatest amount of volunteer potatoes, with populations decreasing over consecutive years if effective control measures are implemented. It is unlikely that individual tubers persist longer than one growing season; tubers remaining in the field develop new daughter tubers each year. For example, some red tubers were harvested from a field in Western Washington that was planted to a white variety. The individual red potatoes were the result of multiple regenerations perpetuated from a planting three years earlier. Crop competition contributes to the reduction in volunteer populations. However, even with competitive rotational crops and cold temperatures, additional means are necessary to effectively manage volunteer potatoes.

Plant Initiation and Emergence

Regeneration of growth from tubers occurs in early spring, once soil temperatures reach favorable levels. Emergence of volunteer plants typically starts in April and continues until the second week in June (Newberry and Thornton). The duration of the emergence period will vary from year to year because of annual changes in environmental conditions and variation in tuber size and depth of placement. Volunteer potatoes are able to generate vigorous regrowth due to the large carbohydrate reserve in the seed tuber or tuber piece. Individual tubers also have the ability to regenerate several sprouts because of multiple eyes, giving them the ability to survive multiple shoot removals. Vigorous plants have been produced from tubers no larger than garbanzo beans (approximately 3/8” in diameter) located as deep as eight inches in the soil (Figure 3). Even the smallest tubers are able to survive the winter and produce a volunteer plant the following spring. Moreover, variable tuber size may contribute to variable emergence of the volunteers in the spring. This is important to keep in mind because various flushes of volunteers may impact management strategies.

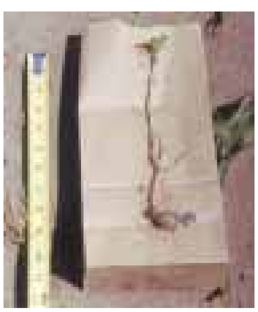

Figure 3: Volunteer potato plant emerging from a small tuber buried over eight inches deep (Newberry and Thornton).

Growth and Development

Once a tuber reinitiates growth, it develops very aggressively and competitively. Newly developing plants have been shown to live off energy reserves of the mother tuber for twenty or more days, giving them a competitive advantage over plants growing from a small seed. This advantage is even greater under stressful conditions. Although photosynthesis in volunteer potatoes begins as soon as the first leaf emerges, a significant amount of carbohydrates is still drawn from the mother tuber until new tuber initiation of the daughter plant.

Shoot removal tests have shown that volunteer potatoes have sufficient food reserves in the mother tuber to regrow new shoots following several removals of the initial shoots. This allows daughter tubers to form before initiating control measures, making management of volunteer potatoes more difficult in future years. By the time tuber initiation occurs, much of the food reserves in the mother tuber has been depleted, but re-sprouting from the mother tuber is still likely to occur.

As the volunteer potato grows, it depletes nutrients and water intended for the rotational crop. In less competitive crops, such as onions and carrots, the volunteer plants can be very effective at simply shading out the developing crop. The size of the mother tuber affects the competitiveness of the volunteer plant and the resulting size and number of daughter tubers. As the size of the mother tuber increases, stem number increases, resulting in a denser stand of volunteer potato plants and a rise in daughter tuber density. Therefore, plants developing from smaller mother tubers may be less competitive, easier to manage, and leave behind fewer daughter tubers than those originating from large mother tubers. Ultimately, the number and size of tubers produced by volunteer potatoes vary, depending on management methods, vigor, disease incidence, size of mother tubers, depth of burial, and crop competition.

Seed and Tuber Production

Volunteer potato plants have the ability to produce a large number of tubers as well as true seed. Potato true seed production ranges from 27 to 100 million seeds per acre in parts of the world that raise varieties capable of producing a true seed. While true seed production can be immense, the majority of the emerging volunteers in the PNW originate from daughter tubers, as most varieties grown in the area are not capable of producing a true seed. However, increased use of European cultivars in the United States may increase the potential for volunteer plants developing from true seed.

In the Columbia Basin, the number of tubers left after harvest ranged from 25,600 to 183,485 tubers per acre with an average of 73,550 tubers per acre (Newberry and Thornton). This is greater than four times the number of tubers used in commercial plantings (12,800 to 19,200 seed pieces/acre). The same study indicated the number of tubers with spring regrowth following a mild winter ranged from 1,600 to 41,000 plants per acre, with an average of 16,606 plants per acre. The study also showed significant reduction in spring regrowth following a winter in which damaging temperatures occurred. In the coldest year of the study, ten fields had complete kill of volunteer tubers and no volunteer plants were detected. The choice of rotational crop also has the ability to limit tuber number and size.

MANAGEMENT OPTIONS

Volunteer potatoes can be competitive as a weed, harbor harmful insects, and cause disease and nematode infestations. Moreover, they can regenerate within rotational crops to contaminate potato seed crops or commercial crops of potatoes. Management of volunteer potatoes is very important, extremely difficult, and can only be achieved by using integrated management methods. Volunteer potato management should consider three main goals: (1) reduce volunteer potato competition within rotational crops to prevent yield loss; (2) eliminate new tuber production by volunteer potatoes within rotational crops to reduce losses and control measures required in the succeeding crop; and (3) restrict the number of volunteer potatoes serving as hosts for potato diseases and pests.

Throughout the remainder of this bulletin we will discuss potential management options within rotational crops. Each option will be evaluated based on the criteria established by these goals. Management options are broken down into five approaches: cultural, mechanical, biological, preventative, and chemical. Cultural management includes cropping practices that reduce the rate at which pests colonize a field or make the crop environment less suitable for pest survival. For volunteer potatoes, competitive crops may be chosen for a rotation and sound agronomic practices applied in the commercial potato crop to reduce the number of undersized tubers left in the field. Mechanical management involves the use of equipment to remove or destroy tubers and plants. An example of mechanical management would be a shallow tillage operation after harvest. Biological management utilizes living organisms or natural enemies to suppress populations of pests. Preventative management focuses on the cause of the problem, preventing the introduction of volunteer tubers to fields. Chemical management is one of the most commonly used methods for managing volunteer potatoes and may involve the use of herbicides and fumigants in rotational crops as well as maleic hydrazide, a sprout inhibitor, in the potato crop. The use of all of these management strategies must be combined in a collaborative holistic approach to address volunteer potato management.

I. Cultural

Crop rotation is practiced on most of the potato growing acres of the Pacific Northwest. Rotation presents an opportunity to choose competitive crops with cultivation and herbicide options to reduce the number and impact of volunteer potato plants. Winter or spring wheat or spring barley following potatoes provides strong competition to volunteer plants, compared to less vigorous shorter season crops like beans or peas.

In the PNW, cereal grain competition reduced shoot emergence from tuber leavings and subsequent daughter tuber production by 50 percent, compared to a less competitive crop. Volunteer plants produced four daughter tubers in a less competitive open canopy crop, compared to only two daughter tubers per plant in a winter wheat crop. However, herbicide or cultivation options for volunteer potato management in winter wheat are limited.

Planting competitive, long season crops does not eliminate volunteer potatoes but it does reduce tuber number and size in comparison to growing a less competitive crop in rotation. Although less competitive crops may not be as effective at reducing the volunteer potato problem as those that are more competitive, any degree of crop competition is very important in the overall management strategy. Moreover, rotational crops, whether competitive or not, may provide effective chemical or mechanical tools to reduce volunteer potatoes.

Management of the commercial potato crop is an integral part of reducing the number of volunteer potatoes. A healthy potato crop with a uniform set of large, easily harvested tubers is less likely to have small tubers that fall through the chains on the potato harvester. Good potato health management practices involve proper seedbed preparation and spacing at planting, fertility management, soil moisture management, and reduction of diseases such as *Rhizoctonia* that, when present, reduce tuber size. A healthy commercial potato crop will not only pay for itself—it can also help reduce costs of managing volunteer potatoes.

Grazing is another practice that has shown positive results in reducing volunteer tuber numbers. In Tasmania, sheep are allowed to graze potato fields after harvest, feeding on the tubers left in the fields. Cattle may also be effective, but are more prone to choke on the potatoes.

II. Mechanical

Mechanical tillage to manage volunteer potatoes can be used in conjunction with other management practices to reduce or suppress volunteer potato plant numbers. Washington studies have shown that light tillage in the fall reduces the number of emerging plants in the spring. Any type of deep cultivation that places tubers deeper in the soil where they can be protected from killing frosts should be avoided. A Washington study showed that it is not beneficial to use a moldboard plow for tillage after potato harvest. The best options for tillage would be a rod cultivator or a paraplow. Another effective option is to fall plow following freezing temperatures to expose deeper tubers to additional winter cold temperatures. The greater the number of tubers left at the soil surface the better.

Studies have shown that cultivation of volunteer potato plants in corn reduces daughter tuber numbers. In a Washington study, cultivating four times during the season greatly reduced volunteer plant vigor and subsequent daughter tuber number. Plants were cultivated when volunteers were at the six- to eight-leaf stage and stolons were hooking, followed by additional cultivations each time the plants re-grew to this stage. Disking early emerging potato plants before planting corn also reduced early season competition in conventionally tilled corn. Preplant applications of glyphosate in no-till corn had the same effect. Herbicide treatments alone do not completely eliminate volunteer potatoes, however. Cultivating seven to ten days after a post-emergence herbicide application improves volunteer potato management and greatly reduces the number of daughter tubers produced.

Another management option for reducing volunteer potatoes is to collect and crush potatoes on the harvester. This is not a general practice, but has been considered in Scotland and may become more practical as technology advances. Harvesters can be designed with a method of collecting small tubers that fall through the chains. These are then sent through a crusher at the rear of the machine. This method is compromised by small stones and may not be effective if tubers are too small. Another option is to use smaller pitch chains on the harvester to collect smaller tubers during a second harvest, and utilize them for special processing needs or animal feed.

III. Biological

Biological management with Colorado potato beetle (*Leptinotarsa decemlineata Say*) fits very well into an integrated volunteer potato management plan. Colorado potato beetle (CPB) is an insect that feeds on potato foliage. CPB can completely defoliate plants in a short amount of time, consequently reducing daughter tuber size and number. However, defoliation of volunteer potato plants by natural populations of CPB often occurs too late to prevent yield loss of the rotation crop or to substantially reduce new daughter tubers. Volunteer plant defoliation by CPB, when coupled with effective early season herbicides or other methods, can result in improved volunteer potato plant management and reduce the weight and size of daughter tubers produced. Shoots emerging from smaller size tubers are less vigorous and therefore may be easier to manage in subsequent crop rotations. Insecticide use in rotational crops such as corn, onions, and carrots may need to be modified in order to allow CPB to defoliate volunteer potato plants and other solanaceous weeds.

The use of early season herbicides in combination with later season feeding of the CPB has been shown to suppress daughter tuber production. Washington studies have shown a decrease in volunteer potato competition in corn and onions due to late season CPB defoliation. However, encouraging CPB populations on volunteer potatoes has the potential to be detrimental if they move to commercial potato crops after defoliating volunteer potatoes. Managers must evaluate the benefits versus the potential risks. In areas using insecticides at planting time or seed treatment insecticides, the CPB threat for commercial fields may not be a concern.

IV. Preventative

Preventative methods can be highly effective and, next to killing low temperatures, can be one of the most economical strategies to implement. Preventative management strategies that can be integrated into a holistic approach include harvester management, harvesting after plants are dead rather than still green, and the application of a sprout inhibitor. In the Cultural Practice section of this bulletin, overall agronomic health of the commercial potato crop was discussed and should also be considered as a preventative management option. Good agronomic health of the potato crop pays dividends for the current crop and helps suppress volunteer potato numbers.

Harvest Management Considerations

Sound harvest practices can help producers get the most out of their current crop while reducing the tuber loss that leads to a volunteer potato problem in a rotation crop. Although the main concern during commercial potato harvest is bruise management, the following additional steps will help minimize tubers lost during harvest.

- Blade depth Manage blade depth to assure that all tubers are being removed from the soil. If the blade is too shallow, tubers will be sliced and a portion of individual tubers will be left in the soil.
- Haulm separation Operate harvester to achieve removal of tubers from stems so they do not get carried off of the harvester.
- Truck loading Position trucks receiving harvested tubers to prevent spillage.
- Tuber intake Operate harvesters to avoid pushing tubers out around the throat of the harvester.
- Forward speed Use the optimal ratio of forward speed to chain speed to maximize soil separation and tuber transport.
- Primary chain gap size Gaps between links on the primary chain should be properly sized to minimize the number of tubers that fall through. Of course, this must be compatible with intended market.

A factor to consider before harvest is the condition of the potato vines. Both premature vine senescence and green versus dead plants at harvest have been shown to affect tuber depth in the soil profile and the amount of tubers left after harvest. Many manageable agronomic factors contribute to premature vine senescence in the potato crop. These factors include fertility, soil moisture management, and disease and pest management. In a Washington study, fields that senesced early had a higher percentage of smaller tubers and consequently a greater number of tuber leavings than late senescing fields. In fields where harvested plants were green, the average number and weight of tubers were more than double that of fields harvested when plants were dead.

Tuber depth was also affected by plant senescence. Fields harvested green had 75 percent of the tuber leavings on or within four inches of the soil, compared to 34.2 percent for fields harvested when plants were dead. When green plants are harvested, tubers are concentrated in the upper levels of the soil where they will more likely be subjected to freezing temperatures. Green plant harvest also leaves larger tubers in the field after harvest. Harvesting when plants are dead will not leave as many tubers in the upper portion of the soil and will not leave as many large tubers.

Application of the sprout inhibitor maleic hydrazide (MH-30) to plants during the growing season can be used to suppress volunteer potato plant numbers. MH-30 is a growth regulator that supresses tuber sprouting when it is applied three to four weeks before normal harvest but at least two weeks before vine kill. The effectiveness of sprout suppression varies by cultivar and by tuber size. Studies found the residue level of MH-30 present in the small tubers that make up the majority of harvest leavings to be lower than that found in larger tubers normally taken to storage. In some cultivars, an application of MH-30 can significantly reduce the number of volunteer potato plants the following spring, especially if there are many large tubers in the leavings. Because of the variability in residual MH-30 concentration in tubers of different cultivars and of different size, research is underway to determine optimal timing of applications. No conclusive results are currently available.

V. Chemical

Many chemicals are available for managing volunteer potatoes (Table 2). Use of herbicides and soil fumigants can assist in management of the volunteer potato problem and should be considered in conjunction with other management techniques as part of an integrated weed management plan. Some herbicides may restrict future cropping or re-cropping options; they should be managed properly and according to the label guidelines. Always refer to herbicide labels and the PNW Weed Control Handbook to determine legal product use and application rates.

Fumigation may have potential as a management tool to help suppress volunteer plant growth in less competitive crops with limited herbicide options such as onions, carrots, and peas. The cost of fumigation limits its use to high value crops and is normally used to help suppress nematodes and other soil pathogens. A fall or spring soil application of 1,3-D (Telone®) shanked in plus sprinkler-applied metham sodium (Vapam®) on commercial fields reduced viable tubers by approximately 75 percent (Boydston and Williams). Metham sodium is commonly used in the PNW through center pivot irrigation. It can reduce populations of annual weeds up to 95 percent. Results from soil fumigation can be variable due to nonuniformity of fumigant application, uneven distribution of fumigant in the soil profile, and use of sublethal doses. During winters where soil temperatures were low enough to kill tubers in the top four inches of the soil, a shanked application of 1,3-D was more effective at managing deeper tubers than sprinkler-applied metham sodium (Boydston and Williams). Conversely, sprinkler-applied metham sodium may be more effective in years when a killing frost does not occur and shallower tubers could potentially be suppressed by a late summer or late spring application. Both dormant and nondormant tubers have been shown to be susceptible to metham sodium, but further research is needed on this topic. The effect of soil moisture and temperature on fumigant dose is not well defined but has been shown to have potential for refining fumigant application timings to obtain suppression.

Corn has several herbicides labeled for management of volunteer potato growth and daughter tuber formation. Applications of atrazine followed by a post application of dicamba and 2,4-D effectively suppress volunteer potatoes (Boydston). The disadvantage of using atrazine is the limit it poses for the following crop. Another effective combination is a postemergence application of fluroxypyr (Starane®) following a pre-emergence application of atrazine. These treatments can be further improved in combination with cultivation, dammer-diker operations, or a late season Colorado potato beetle defoliation. Boydston's study showed a single mid-postemergence application of carfentrazone-ethyl (Aim®) plus dicamba (Clarity®) reduced daughter tuber weights by 76 to 96 percent. Carfentrazone, which acts primarily by contact activity, requires multiple applications to manage regrowth of new potato shoots when used alone. This study also showed that the combination treatment had similar corn yield compared to the hand-weeded check.

Mesotrione (Callisto®) is a new product that effectively controls or suppresses volunteer potatoes and is registered for use in field corn. Volunteer potato control, tuber production, and corn yield were evaluated following treatment with several herbicides and herbicide combinations (Boydston and Williams). Mesotrione greatly reduced both the number of daughter tubers produced as well as tuber biomass compared to the other postemergence herbicide treatments tested. Mesotrione applied postemergence at the time of early potato tuber initiation reduced daughter tuber number and weight by 95 and 99 percent, respectively, compared to non-treated checks. The few daughter tubers that were formed often produced weakened sprouts, and sprouts were slow to emerge the following spring. The corn yield of all the mesotrione treated plots was equal to the hand-weeded check. Some crop rotations may be restricted with the use of mesotrione. Sensitive crops include peas, beans, and alfalfa. Before using mesotrione, please refer to the manufacturer's label for application instructions as well as more information on rotation restrictions.

In late-planted crops or in no-till corn, glyphosate applications can be used to manage early emerging volunteer plants. An application made pre-plant will kill the shoots of emerged potatoes, but new shoots frequently emerge two to three weeks later. Consequently, subsequent methods will have to be used to adequately manage daughter tuber production. Maximizing shoot emergence prior to glyphosate application results in less potato regrowth following herbicide application than with earlier herbicide application.

Onions are another rotation crop with limited options for managing volunteer potatoes. Cultivation alone has shown some level of effectiveness, but does not remove volunteer potatoes in the plant row. Multiple applications of oxyfluorfen (Goal®) in combination with cultivation has been shown to maintain onion yield (Boydston and Seymour). Applications of oxyfluorfen at the two-, three-, and four- to five-leaf stages of onions, followed by a cultivation after each application, reduced daughter tuber weight 69 to 96 percent and tuber number 32 to 86 percent compared with cultivation alone. This labeled application in onions proved to be quite beneficial. Other herbicides tested were effective in suppressing volunteer plants, but were phytotoxic to onions and reduced yield.

Cereal crops are often grown in rotation following a potato crop. For those volunteer plants present in a wheat crop there are limited chemical management options. Fall-planted cereals delay the emergence of volunteer potatoes in the spring. Fluroxypyr and metsulfuron-methyl can suppress emerged potato shoots, but applications must be made at specific stages of cereal growth, during which potato shoots have often not yet emerged. A pre-harvest application of glyphosate can be applied to wheat (except seed wheat) at 30 percent or less grain moisture (hard dough stage) for management of volunteer potatoes. However, volunteer potatoes are usually water stressed at this time, below the wheat canopy, and have already formed daughter tubers, reducing the effectiveness of this option. Glyphosate can also be applied post harvest. Oregon studies have shown that an application of glyphosate to volunteer potato plants when the tubers are over two ounces can reduce tuber viability. Results from a glyphosate application at these times can vary, depending on the size of the volunteer plants and tubers, the condition of the plants, and the moisture availability. It may be necessary to make multiple applications to achieve adequate suppression.

Check List of Measures to Manage Volunteer Potatoes

There is no one single measure for volunteer potato management.
The key is a holistic approach, integrating multiple tactics.

Maintain sound agronomic practices in the potato crop to reduce undersize tubers

- Irrigation management
- Fertility management
- Seed spacing and seedbed preparation
- Disease reduction
- Management to ensure a uniform crop

Maintain sound harvest practices

- Use proper blade depth, to ensure all tubers are removed
- Employ Haulm separation to remove tubers from stems
- Load trucks properly to reduce spillage
- Operate the harvester to avoid pushing tubers around the throat of the harvester
- Correctly employ the forward speed to chain speed ratio

Crop rotation

- Plant competitive crops or crops with control options such as corn, winter or spring wheat, or canola
- Avoid slow growing non-competitive crops that have few control options

Biological management considerations

- Colorado potato beetle defoliation of volunteers in rotation

Chemical management considerations

- Use pre-plant soil fumigants in high value crops
- Use pre-harvest herbicides such as glyphosate
- Use broadleaf herbicides in rotational crops to reduce tuber number and weight
- Apply maleic hydrazide; time application to tuber size as recommended on the label

Field selection considerations

- Know your field history and avoid fields with potential high volunteer populations
- Select rotational crop to match volunteer potato potential

Mechanical management considerations

- Multiple cultivations starting at the 6–8 leaf stage
- Use the Para Plow® or rod cultivation
- Do not use a moldboard plow after harvest
- Maximize frost exposure

Volunteer Potato Management with Various Herbicides in PNW Crops

The following herbicides are labeled in the Pacific Northwest, either individually or in all three states. Please follow environmental precautions on individual herbicide labels, and observe label restrictions on herbicide movement to surface or groundwater. Important: *Always read and follow label instructions before buying or using these products.*

Herbicide

Chemical Name	Trade Name	Manu-facturer	Crop	Soil or Foliar Application	Contact or Systemic	Level of Control
1,3-D	Telone	Dow	~	Soil	Fumigant	Fair-Good
2,4-D	Various	Various	Corn	Foliar	Systemic	Fair
Atrazine*	Various	Various	Corn	Soil, Foliar	Contact	Good
Bromoxynil	Buctril	Bayer	Onions	Foliar	Contact	Fair
Carfentrazone-ethyl	Aim	FMC	Corn, wheat, barley	Foliar	Contact	Fair
Clomazone*	Command	FMC	Cucurbits, peas	Soil	Systemic	Fair
Clopyralid*	Stinger, Curtail	Dow	Mint, grass, cereals, sugarbeets	Foliar	Systemic	Fair
Dicamba*	Banvil, Clarity Distinct	Various	Corn, cereals, grass	Foliar	Systemic	Fair-Good
Ethofumesate	Nortron	Bayer	Sugarbeets	Soil, Foliar	Soil	Fair
Fluroxypyr	Starane	Dow	Corn, wheat	Foliar	Systemic	Fair-Good
Fomesafen	Reflex	Syngenta	Beans	Foliar	Contact	Fair-Good
Glyphosate	Various	Various	Non-Selective, many	Foliar	Systemic	Fair-Good
Imazamox*	Raptor	BASF	Beans, alfalfa	Foliar	Systemic	Fair-Good
Imazethapyr*	Pursuit	BASF	Beans, alfalfa	Foliar	Systemic	Fair-Good
Maleic hyrdrazide	MH-30, various	Various	Potato	Foliar	Systemic	Fair-Good
MCPA, MCPB	Various	Various	Peas	Foliar	Systemic	Fair
Mesotrione*	Callisto	Syngenta	Corn	Soil, Foliar	Systemic	Good
Metam Sodium	Various	Various	~	Soil	Fumigant	Fair-Good
Metsulfuron-methyl*	Ally, Escort	DuPont	Small grains	Foliar	Systemic	Fair-Good
Oxyfluorfen	Goal	Dow	Onions	Foliar	Contact	Fair-Good
Paraquat	Gramoxone Max	Syngenta	Non-Selective	Foliar	Contact	Fair
Picloram*	Tordon	Dow	Pasture	Foliar	Systemic	Good
Pyridate	Tough	Syngenta	Mint	Foliar	Contact	Fair
Thifensulfuron-methyl*	Harmony	DuPont	Small grains	Foliar	Systemic	Fair-Good

Ratings for Level of Control

G = Good F = Fair P = Poor NC = No Control

* Please see product label for rotational restriction guidelines

CONCLUSION

Our biggest ally in reducing volunteer potato populations is cold winter temperatures, which should be kept in mind when making volunteer potato management decisions. Freezing temperatures in most years will kill tubers from the surface down to two inches in the soil. Tubers exposed to 50 frost hours at temperatures below 28°F will not survive. Studies done in Washington have shown that these temperatures only occur one in four years. Shallow tubers are also subject to damage from birds and other pests, and destruction from bacteria and fungi. Therefore, managing tuber depth is crucial.

Volunteer potatoes can negate the positive effects of crop rotation, such as declines in disease, insect pests, and nematode populations. Volunteer potatoes are a very competitive weed, especially for less competitive crops grown in rotation. Seed producers are also faced with volunteer potato problems because of potential contamination of their seed crop. The biology of this weed shows it to be winter hardy, vigorous, and able to persist despite management efforts.

Some varieties of volunteer potatoes have the potential to produce a tremendous amount of true seed, although in the PNW the main source of the volunteer problem is the tubers remaining in fields following harvest. Much progress has been made in the management of this pest in terms of chemical, mechanical, and cultural practices in the last decade in the PNW. No one management method is the silver bullet, and an integrated plan tailored to meet the specific needs of the cropping system is the best management option.

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