BUL 1038

Agronomics of Leasing Fields for Potato Production

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Contents

Introduction

LEASING OR RENTING FIELDS for potato production facilitates greater access to available acreage, locations, and opportunities. These fields may come with historical knowledge on yield potential, previous crops, water availability and irrigation capacity, irrigation method, soil properties, pest prevalence, and pesticide use history, all of which make agronomic and management decisions simpler. Unfortunately, not all leased or rented fields have this background information and many unknowns need to be identified and risks considered prior to preparing the fields for potato production.

The purpose of this bulletin is to identify agronomic considerations in leasing or renting fields for potato production and to facilitate further discussions regarding

what may or may not be known about the field (Figure 1). Decisions on field management can then be further fine-tuned to the leased field to help maximize the yield and quality potential for the potato crop. If complete information is not available, are there effective steps that can be taken to mitigate an unknown risk?

Figure 1. There are numerous agronomic considerations in leasing a field for potato production.

Options for renting or leasing fields are variable and the land value fluctuates. Fields can be rented for a single growing season, leased for a year, or leased and committed to a long-term contract. For this bulletin, the term "leased" refers to both rented and leased fields. Leasing a field does not always allow the lessee to make infrastructural updates or long-term agronomic decisions, which can decrease the breadth of agronomic solutions available to the lessee. Additional agronomic options may need to be investigated to overcome the inability to manage a field for long-term production.

When considering leasing a field for potato production, the roles and obligations between the landowner and lessee should be thoroughly communicated. There are many topics to cover in those conversations, but specifically communications should include who is responsible for irrigation issues and maintenance and what is the plan of action if an irrigation system breakdown occurs. Responsibility for weed control along the field and fence lines, as well as fence maintenance, needs to be clearly stated. Overall, there should be clear communication on whether the lessee can carry out their normal agronomic practices in the leased fields or if there are stipulations or constraints, such as limitations on water availability or the use of specific agrichemicals. It is best to define these in writing. Water availability is especially important to southern Idaho. Both parties need to know the jurisdiction, source, and level or age of the water rights in order to select which variety to grow and how to manage irrigation. Knowing the details of the irrigation system are vital to anticipating irrigation issues that may occur during the growing season.

Additional historical information the lessee should gather to enable sound agronomic decisions to grow potatoes include if the field(s) had been previously split between crops or merged between fields, the presence of previous irrigation ditches, and the results of a soil survey regarding type and analysis. Specific preceding management practices that could affect the potato crop include the previous crops, application of manure, compost or use of green manures, crop years with potatoes, pesticide applications, and tillage practices.

The following subsections provide greater detail on the agronomic considerations, options for obtaining tests or records, potential management solutions, and general questions to ask the owner regarding the leased field. The following sections cover herbicides and weeds, nematodes, soilborne diseases, insects, agronomic management and variety selection, and foreign material considerations.

Herbicides and Weeds

Production of most field crops rely almost exclusively on herbicides for weed control. A significant number of these herbicides have the potential to carry over to the next crop (e.g., potatoes) and cause injury and possibly yield loss. It is, therefore, important to ask some basic questions about weeds and past weed-control practices before leasing land for potato production. These include, but are not limited, to the following:

1. What are the most common weeds on the land?
2. Are there any herbicide-resistant weeds? If so, which weeds and what herbicides are they resistant to?
3. Are there any standards for weed control or are there any herbicides prohibited on the property?

4. What were the previous crops in the past 3–5 years and which herbicides were used for weed control in those crops?
5. Who is responsible for controlling weeds in field borders, roadsides, fence lines, etc.?

Let's examine these questions in more detail.

What are the most common weeds on the land?

Not all weeds are created equal. Some are more difficult to control in potatoes than others. Grassy weeds, including downy brome, foxtails, wild oat, and barnyard grass, are relatively easy to control in broadleaf crops like potatoes. However, broadleaf weeds like hairy/black nightshade, common lambsquarters, kochia, redroot pigweed, Canada thistle, and field bindweed are relatively more difficult to control. It is important to know the common weeds on the land to develop a good weed management plan.

Are there any herbicide-resistant weeds? If so, which weeds and what herbicides are they resistant to?

There are at least twelve weeds that have developed resistance to commonly used herbicides in Idaho. These include weeds like redroot pigweed and kochia, which are common weeds found in potatoes grown in Idaho. Information on herbicide resistance would help determine if there are any weeds resistant to commonly used potato herbicides like rimsulfuron (e.g., Matrix), metribuzin (e.g., TriCor), dimethenamid-p (e.g., Outlook), EPTC (e.g., Eptam), etc.

Are there any standards for weed control or are there any herbicides prohibited on the property?

Some lands may be in organic production and the property owners might like to keep it that way. In addition, some landowners may have restrictions on the use of specific herbicides due to drift or health concerns. It is important to know if there are any specific herbicide restrictions as this would affect your weed management options.

Who is responsible for controlling weeds in field borders, roadsides, fence lines, etc.?

Weeds that grow along field borders will not impact your crop yields. However, if left unmanaged, weeds along fence lines, roadsides, ditch banks, center pivot corners, etc., can be breeding grounds for troublesome weeds, including herbicide-resistant ones. Tumbleweeds like kochia, mustard, tumble pigweed, Russian thistle, and others can move from field borders and spread their seeds on the farm. Thus, even if you do everything right by limiting weed seed production in your field, weed seeds (including herbicide-resistant weeds), may be introduced to your farm from field borders. Again, perennial weeds such as Canada thistle, field bindweed, quackgrass, and others that spread through roots can creep in from field borders. It is therefore important to designate responsibility for managing weeds in field borders in the lease agreement.

What were the previous crops in the past 3–5 years and which herbicides were used for weed control in those crops?

Herbicide residue left in the soil (carryover) from the previous season or year(s) can injure potatoes. The risk of herbicide carryover to the next crop is determined by a myriad of factors, including but not limited to: 1) the type of herbicide and innate persistence of the herbicide (Table 1); 2) amount of moisture (irrigation and precipitation); 3) soil type and characteristics; 4) herbicide application rate; 5) length of time between herbicide application and the planting of potatoes; and 6) cultural practices (e.g., tillage). It is important to know the herbicides that were applied and determine if there might be residues in the soil at concentrations high enough to injure the potatoes. Carefully read the label of the herbicides applied and, if needed, conduct a bioassay or laboratory analysis of soil samples as described in the sidebar, "Conducting a Bioassay," on page 5.

Table 1. Common herbicides used in Idaho and rotation restrictions to potatoes.

Herbicide	Months after Application
thifensulfuron + tribenuron + metsulfuron-methyl (Ally Extra)	34
imazethapyr (Pursuit)	26
quinclorac (Facet L)	24
chlorsulfuron (Glean)	FBAR
imazamox (Beyond/Raptor)	18
clopyralid (Stinger)	18
clopyralid + fluroxypyr (WideMatch)	18
nicosulfuron (Accent)	18
(bromoxynil + pyrasulfotole + thiencarbazone-methyl) Huskie Complete)	18
ethofumesate (Nortron)	12
triallate (Far-GO/Avadex)	12
mesotrione (Callisto)	10
mesosulfuron-methyl (Osprey)	10
flucarbazone-sodium (Everest)	9
fenoxaprop-P-ethyl + pyrasulfotole + bromoxynil (Wolverine Advanced)	9
pyroxsulam (PowerFlex)	9
florasulam + fluroxypyr + pyroxsulam (GoldSky)	9
bromoxynil + pyrasulfotole (Huskie)	9

FBAR = field bioassay required

Herbicide Group 2: Herbicides such as metsulfuron-methyl (Ally Extra), imazamox (Raptor, Beyond), and imazethapyr (Pursuit) are often used in Idaho and can carry over to potatoes. Raptor is used in alfalfa, dry bean, and peas and Beyond is used in clear-field wheat. Both herbicides have an 18-month plant-back restriction to potatoes. Pursuit is used in alfalfa, dry bean, and peas and has a 26-month plant-back restriction to potatoes.

Herbicide Group 3: This group of herbicides includes soil-applied herbicides such as pendimethalin (Prowl H2O), ethalfluralin (Sonalan), and trifluralin (Treflan) used for preemergence weed control in alfalfa, corn, dry beans, potatoes, wheat, etc. Generally, these herbicides have relatively short plant-back restrictions to potatoes since most are labeled for use in potatoes.

Herbicide Group 4: These are plant growth regulators that include herbicides like 2,4-D (2,4-D LV 6), clopyralid (Stinger), MCPA (MCPA Ester 4), fluroxypyr (Starane), and dicamba (Clarity), among others. A significant number of herbicides in this group (e.g., picloram [Tordon], aminopyralid [Milestone], triclopyr [Garlon], quinclorac [Paramount/Facet L]) are labeled for use in noncrop areas and could have very long (up to 36 months) plant-back restriction to potatoes. It is important to keep this in mind when leasing a field that has been in pasture or other noncrop uses.

Herbicide Group 5: This group includes herbicides like metribuzin (TriCor, Sencor, Dimetric), terbacil (Sinbar), atrazine (AAtrex, Atrazine 4L), and hexazinone (Velpar). Metribuzin is mostly used on potatoes and Sinbar and Velpar are used in alfalfa. Atrazine is used mostly on corn. These herbicides have up to 24 months of plant-back restriction to potatoes.

Herbicide Group 9: These are herbicides with the active ingredient glyphosate. This includes Roundup herbicides like PowerMAX/WeatherMAX, Cornerstone, Touchdown, Buccaneer, etc. Potatoes can be planted anytime following the application of these herbicides.

Herbicide Group 14: This group comprises mostly contact herbicides (i.e., they kill or burn any green plant tissue they come into contact with). Therefore, most of these herbicides (e.g., carfentrazone-ethyl [Aim EC], saflufenacil [Sharpen], tiafenacil [Reviton], pyraflufen-ethyl [Vida], etc.) are short-lived in the soil. In fact, most are used for potato vine kill. Nonetheless, herbicides like Spartan, a herbicide labeled for use in spring wheat and safflower, have about 12 months of plant-back restriction to potatoes.

Herbicide Group 15: This includes herbicides like pyroxasulfone (Zidua), dimethenamid-p (Outlook), S-metolachlor (Dual II Magnum), and acetochlor (Warrant), among others. Ethofumesate (Nortron) and EPTC (Eptam) have also been recently reclassified as group 15 herbicides. Although most of the herbicides in this group are labeled for use in potatoes, some active ingredients in this group can carry over and injure potatoes the following season. For example, Nortron and triallate (Far-GO/Avadex) have 12-month plant-back restrictions to potatoes.

Herbicide Group 27: Herbicides in this group are mostly used in cereal crops. This includes small grain herbicides like pyrasulfotole (component of Huskie and Huskie Complete), bicyclopyrone (a component of Talinor), and corn herbicides like mesotrione (Callisto) and topramezone (Impact). Huskie and Talinor have a 9-month plant-back restriction to potatoes.

Bioassay

If you know which herbicides were applied and the rates and timing of their application in the previous season, first consult the herbicide label to see the plant-back restrictions to potatoes. This will let you know whether or not it is safe to plant potatoes.

If you are not sure which herbicides were applied or the rates and timing of their application, it is recommended that you conduct a bioassay to determine if it will be safe to plant potatoes. Even if you are sure of the herbicides, rates, and timing of application, a bioassay or laboratory analysis is recommended. (See “Conducting a Bioassay” herein.)

Conducting a Bioassay

To conduct a bioassay, collect soil samples from the top 3–6 inches (3 inches in nontilled and 6 inches in tilled soils) at the worst parts of the farm (lowest organic matter, eroded, poorly drained, etc.). You should collect about 5 pounds of soil (about an ice-cream bucketful) and mix thoroughly. Collect an equal amount of soil from a field not treated with any herbicides. Your backyard or garden is often the ideal location. Place the two soil samples (one from the farm that had herbicides and the other from nonherbicide-treated soil) in wooden boxes or pots and plant 6–10 seed potatoes in each soil. Ideally, space the tubers as they would be spaced in a field—that is, if you have a larger container, you can plant more tubers. Place the pots in a sunny location and water as needed to enable the seeds to emerge. As soon as they emerge, observe the living plants in the herbicide-treated soil for signs of herbicide damage.

If you cannot conduct a bioassay, collect soil samples from the herbicide-treated field as described above and send them to a nearby laboratory for residue analyses. Note that laboratory analyses can be very expensive, so it is helpful to let the laboratory know what they are analyzing for. In other words, know the herbicide-application history so that the laboratory can conduct a specific residue analysis. The responsibility for paying for the laboratory soil analysis should be specified in the lease agreement.

Nematodes

High nematode populations can cause reductions in potato yield and quality, thereby contributing to economic loss. Among all nematodes found in Idaho soils, three classes cause most of the damage in potato fields: root-knot, root-lesion, and stubby-root nematodes. Increased nematode pressure negatively impacts potato production in several ways. Root-lesion and root-knot nematodes feed on roots and reduce yield. Root-lesion nematodes interact with the soilborne fungus, *Verticillium dahliae*, exacerbating potato early dying. Root-knot nematodes also infect tubers and reduce quality by forming galls near the tuber surface. Stubby-root nematodes transmit tobacco rattle virus, causing corky ring-spot symptoms that render tubers unmarketable. In addition, potatoes destined for export markets can have additional phytosanitary requirements, like free from certain species, such as the Columbia root-knot nematode (*Meloidogyne chitwoodi*).

Historical crop production records and results of soil tests are the best way to identify potential issues with nematodes prior to planting potatoes on leased ground. If a field has been in a long-term potato rotation, request information from grade sheets on the level of root-knot nematode and corky ring spot symptoms observed in the past 2–3 potato crops. Also review the results of soil tests sent to a nematode diagnostic laboratory during that same period to determine if there is a pattern of increasing populations over time.

In addition to historical records, conduct a current soil test prior to planting potatoes. The best time to sample is late summer or fall, while the crop before potatoes is still growing in the field. Sample in the row to increase the number of plant roots in the sample and avoid soils that are too dry, too wet, or frozen. Discard the top 2 inches of dry soil and sample to a depth of 12 inches. Additional information on sampling procedures can be found in the University of Idaho CIS 1056, *Sampling Procedure to Diagnose Nematode Infestations*.

Crop rotation and cropping sequence significantly impact nematode populations and are important considerations for leased fields. Increasing frequency of potatoes in a cropping system tends to result in heightened pressure from nematodes. Increasing the time between potato crops, particularly with rotation crops that are poor hosts, results in reduced risk of nematode damage. This strategy works best for root-knot nematodes, due to their relatively narrow host range, and is less effective for root-lesion and stubby-root nematodes due to their wide host range, including cereal crops. Even within root-knot nematode species, there are important differences in the host range between Columbia (*M. chitwoodi*)

and Northern (*M. hapla*) root-knot nematodes (Table 2). Damage from the Columbia root-knot nematode tends to be worse in potatoes following a small grain crop as compared to corn or other poor nematode hosts. In contrast, damage from Northern root-knot nematode tends to be worse following alfalfa. Regardless of the cropping sequence, good weed control is imperative for rotation crops to reduce nematode populations, since many common weeds like hairy nightshade are very suitable alternative hosts for nematodes.

Table 2. Common crop hosts of root-knot nematodes that infest potatoes. (Adapted from Hafez and Thornton 1992.) "+" = good host, "-" = poor or nonhost.

Crop	Columbia *M. chitwoodi*	Northern *M. hapla*
Alfalfa	+	+
Bean	+	+
Carrot	+	+
Cereal	+	-
Corn	+	-
Grape	-	+
Hop	-	-
Mint	-	+
Pea	+	+
Sugar Beet	+	+

The options for dealing with high populations of potato-damaging nematodes on leased fields can be limited. Populations above thresholds recommended for effective chemical control may necessitate a decision to not plant potatoes for several years to allow crop rotation to bring down the nematode counts to acceptable levels. More moderate populations of nematodes can be effectively managed through the use of a fumigant and/or nonfumigant nematicide. Combining nematicides with green manure crops specific to the target species of nematodes is also an effective management strategy. Unfortunately, there are currently no commercial potato varieties that are resistant to root-knot nematode damage. Castle Russet is a recently released variety resistant to development of corky ring spot that would be a good option for fields with high stubby-root nematode and virus levels.

Movement of infested soil on equipment is one of the common ways nematodes are spread to new fields. Therefore, an important consideration in leasing land is to reduce the risk of infesting clean fields by always washing equipment between fields.

General questions to ask:

Are nematode soil test results for previous years available?

What fumigant and nonfumigant nematicides have been applied to the last three potato crops?

Are there any restrictions on nematode management practices (chemicals, rotation, green manure crops) that can be used?

Soilborne Diseases

Like nematodes, soilborne potato pathogens reduce potato yield and quality. Crop history influences the levels of pathogens present in a field at planting. Pathogens such as *Verticillium dahliae* (cause of Verticillium wilt), *Spongospora subterranea* subsp. *subterranea* (cause of powdery scab), *Streptomyces* species (cause of common scab), *Phytophthora erythroseptica* (cause of pink rot), *Pythium* species (cause of Pythium leak), *Sclerotinia sclerotiorum* (cause of white mold), and *Rhizoctonia solani* (cause of Rhizoctonia stem canker and tuber black scurf) can all survive in the soil for extended periods of time. *Sclerotinia sclerotiorum, V. dahliae*, and *R. solani* have wide host ranges. Consequently, rotating with other crops, such as beans, for *S. sclerotiorum* may also increase levels of inoculum in the soil.

Plant disease development requires three elements: a susceptible host, a pathogen, and a favorable environment. All three elements must be present for disease to develop. In some cases, risk of soilborne disease can be estimated by testing soil for the presence and amount of pathogen inoculum. Soil samples can be submitted for laboratory analysis of pathogens such as *V. dahliae*, *S. subterranea*, and *R. solani*.

For example, if populations of *V. dahliae* are high, then the risk of Verticillium will be high. However, the presence of these pathogens alone does not mean disease will be severe, or even occur, since variety susceptibility and environmental conditions contribute to disease development. Regardless, knowing the levels of potential pathogens in the soil is helpful for planning disease management practices.

If the field has a history of Verticillium wilt or soil populations are high, planting resistant potato varieties is the most effective method for managing disease. If a susceptible variety must be planted, fumigation with metam sodium, metam potassium, or chloropicrin can be effective in reducing disease. Metam fumigation is most effective in the fall of the year prior to planting potatoes. Metam can be applied in the spring, but the label requires an interval between application and planting. If metam applications are made in the spring, cultivating and planting can be delayed. Chloropicrin is also effective against Verticillium wilt and can suppress common scab. Be sure to follow the label relating to the time between application and planting.

The presence of the powdery scab organism in the soil may put tubers at risk of developing scab lesions that reduce tuber quality. Additionally, the powdery scab pathogen vectors the potato mop-top virus (PMTV), which causes external and internal tuber blemishes. There currently are no cost-effective pesticides or cultural practices for managing powdery scab or PMTV. Some varieties are less susceptible and do not readily express tubers lesions or PMTV symptoms.

Rhizoctonia stem canker and tuber black scurf can be spread by inoculum in the soil and on infected seed tubers. If soil populations of *R. solani* are known to be high or potatoes are grown in a close rotation (e.g., three years or less), application of an effective fungicide in-furrow at plant will normally provide more effective control of disease than a seed treatment alone.

Fields with a history of pink rot need to be carefully managed. Proper irrigation (avoiding overirrigation), variety selection, and application of appropriate fungicides can be used to manage pink rot. Some fields may have populations of the pink rot pathogen that are resistant to metalaxyl and mefenoxam, the active ingredients in some fungicides. Currently, it is not cost-effective to sample the soil to determine whether the pathogen populations are sensitive or resistant to metalaxyl/mefenoxam. Previous history is the most effective way to determine if resistance is present. Fungicides with other modes of action (e.g., phosphorous acid, oxathiapiprolin) should be used instead if metalaxyl/mefenoxam provided poor control of pink rot in previous years.

It is important to understand water relations in a rented field. Areas with poor water drainage or subwater will be at greater risk for pink rot and Pythium leak. The use of foliar fungicides should be planned when growing potatoes in a field with a history of white mold.

General questions to ask:

What have been the previous disease problems in this field?

What has been the fungicide use history?

Are there any restrictions as to what fungicides can be applied to the potatoes?

Insects

Most arthropod pests of potato are highly mobile and the local pest fauna of an area may disperse into a potato field irrespective of its history. However, certain pests that overwinter in the soil may be of particular concern in rented ground; rotation history is an important factor affecting the damage risk from such pests. Learning the crop rotation history of a field and what at-plant insecticides were recently applied can aid in assessing the risk. Dispersal of arthropod pests from the surrounding crops and landscape should also be considered, especially if the land being leased features landscape with atypical interfaces (e.g., those alongside noncultivated desert or certain crops that may harbor potato pests).

Wireworms are the most important soil-inhabiting pest to consider in an unfamiliar field. Because wireworms are favored by certain crops and may live in the soil for years, crop rotation history has

a strong influence on the risk of damage to potato. Although wireworms feed on most crops and weeds found in Idaho, grasses—including cereals and corn—are favorable to increasing wireworm pressure. Alfalfa, however, is among the few crops grown in Idaho that might reduce pressure. Evaluating the crop history over the previous 3–5 years aids in assessing the potential risk of wireworm damage. Grass-heavy rotations should be of most concern. Recent applications of at-plant insecticides targeting wireworms should somewhat mitigate the risk. Using bait stations to monitor fields before planting provides better information on wireworm densities. Options for dealing with high wireworm populations include fumigation, at-plant insecticides (that may be supplemented with foliar insecticides), or planting a different crop.

Other soil-dwelling arthropods that may be favored by certain crops preceding potato include cutworms, seed-corn maggot (which can increase soft rot bacteria), white grubs, leatherjackets, and the garden symphylan. These pests, especially the latter four, are rarely of economic concern to potato in Idaho. Certain cutworms and white grubs may be more problematic following grass crops, especially pasture. Cutworms may also be favored by an abundance of grassy weeds in the preceding crop. Leatherjackets are more likely to damage potato following spring plowing of alfalfa. Both white grubs and the garden symphylan tend to be associated with soils that are high in organic matter. If damage from the omnivorous garden symphylan has not occurred in previous crops grown in a field, risk to a subsequent potato crop should be low. Damage from seed-corn maggot is usually more severe with cool, wet springs and in soils with high organic matter. Many chemical control options are available for cutworms; however, there are few options for white grubs and the garden symphylan and there are no recommended chemical controls for leatherjackets or seed-corn maggot in potato.

In addition to soil-dwelling arthropods within a field, it can be useful to consider potential arthropod pests that may disperse into a field from the surrounding landscape. Such considerations would not be exceptional for potato in rented ground unless that ground is in an area with unfamiliar crop/landscape interfaces. For example, potato grown near the desert may be at higher risk from insects such as grasshoppers, blister beetles, and beet leafhoppers. Potatoes grown near the previous year's potato fields may be more susceptible to Colorado potato beetle infestations, given that potato is the only major crop host grown in the state and these beetles tend not to disperse long distances. Many pests, including potato psyllids for example, are more abundant at lower elevations, so risk tends to increase toward western Idaho. Finally, many arthropod pests disperse into potato from other crops or weeds, especially as they are harvested or dry down (e.g., aphid vectors of virus dispersing from cereals, alfalfa, or weed hosts). Being cognizant of all the potential sources of arthropod pests and having field-specific monitoring and management plans in place as early as possible helps to mitigate the damage caused by these pests.

General questions to ask:

What have been the previous insect problems in this field? Have wireworms been a recent problem in this field?

What was grown in the field during the past 3–5 years?

What has been the insecticide use history (especially at-plant insecticides and fumigants)?

Are there any restrictions as to what insecticides can be applied to the potatoes?

Agronomic Management and Variety Selection

Potatoes are sensitive to in-season stresses that reduce yield and quality. Growing potatoes in leased fields may constitute a risk if the field history is unknown. Below are a few specific considerations regarding management options and questions to ask when leasing a new field.

Crop rotation, specifically nutrient availability, impacts crop production. Some previous crops like corn may deplete the soil of residual nutrients. Test soils for the macronutrients nitrogen, phosphorus, and potassium and important micronutrients prior to planting and adjust the soil nutrient status by applying the needed amounts of nutrients for emergence and plant establishment. Other conditions to be aware of are soil salt concentration, soil type, and field topography. Request historical soil-test records, especially those that detail fertilizer applications, including manure, for 3–5 years. The more years available, the greater the understanding of how soil-fertility trends fluctuate in potato and other crops. Plant varieties that are more tolerant to stress if there may be suboptimal water conditions and/or other issues. Avoid planting varieties with slow emergence or late maturity if the season length is less than one hundred days.

Soil compaction can impact crop quality. Heavy harvest traffic, especially on wet soils, plowing, or other compacting activities may increase the incidence of green potatoes due to an inability to grow downward through hardpans. Additionally, increased runoff of water and fertilizer may occur due to poor infiltration in compacted soils. This may lead to water and/or nutrient stress in plants when exposed to even moderate stress. Solutions may include using deep tillage equipment to break up hardpans and minimizing the number of passes with heavy equipment through the field.

Reduced water allotment may require a different management plan in the field. Potatoes' response to in-season water stress may include misshapen potato tubers, low yields, and internal and external defects, resulting in reduced marketability. In seasons where water may be reduced due to insufficient availability, it may be advisable to consider other leasing options or planting early season varieties that can reach full maturity and be harvested prior to water cutoffs (Table 3). This option may be dependent on contracting with a processor's and fresh pack shed's supply-and-demand and pack plans.

Table 3. Commonly grown varieties and relative plant maturity. R = Russet.

Plant Maturity	
Early-Medium	**Medium-Late**
Blazer R.	Alpine R.
Classic R.	Clearwater R.
Teton R.	La Belle R.
Ranger R.	Umatilla R.
Shepody	Western R.
Pomerelle R.	R. Burbank
R. Norkotah	Alturas
Caribou R.	Dakota R.

Breakdown of irrigation systems is a common issue in farming operations. Irrigation systems prone to breakdown because of age or poor maintenance may not be suitable for potatoes. Since potatoes require consistent irrigation for adequate yields, and because fluctuations in irrigation can lead to issues like rot, sugar ends, hollow heart, and external defects like knobs and growth cracks, it is important to have dependable irrigation equipment that will function reliably throughout the growing season. It may be advisable to ask the landowner about the functionality of the irrigation system and check the equipment prior to leasing the ground. Additionally, it may be helpful to have an agreement in writing regarding which parties are responsible for specific repairs and the timeliness of making those repairs during the growing season.

Acquire information on field location, irrigation source, and crop surroundings. Neighboring crops may pose a concern with pesticide drift. Assess general field and large equipment accessibility for planting, cultivation, and harvest. Identify the water source (surface or ground) and the water rights and priority dates. Additional questions to ask would include

* procedures (lead time for water requests/ maximum volumes available) and responsibility for requesting water if relying on surface irrigation
* water-storage availability
* age of pumps and irrigation equipment
* availability of variable frequency drives on pumps

General questions to ask:

- Last time the field was in potatoes and the number of years between potato crops
- Previous fertilizer/pesticide application information
- Previous lease management
- Previous rotation and tillage practices
- Irrigation equipment (rill, solid set, wheel lines, pivot) age and maintenance schedule:
  * Can fertilizer be injected into the irrigation system through the growing season?
  * Who is responsible for irrigation system maintenance?
- Accessibility for fertilizer delivery
- Surrounding area obstructions/limitations in case of aerial application of fertilizers or pesticides

Foreign Material

Leasing ground may increase the likelihood of foreign material associated with a harvested potato crop. Many foreign materials originate in a field and not knowing the history of a leased field makes avoiding the risk difficult. Potential foreign material issues initially relate to a field's long-term history and its land-use association—for example, with an old dumpsite, homestead, or cement ditches or if it lies near a busy roadway or even a golf course. Scouting the field and having knowledge of the previous issues with foreign material can indicate the field is at too high of a risk to be leased for potatoes or that action is required to avoid foreign material in a harvested raw product.

Field considerations regarding foreign material:

If the previous crop was corn or alfalfa, the cobs and crowns of the plants can become difficult to remove in a harvested potato crop. Consider an additional year before planting potatoes or implement mechanization at harvest to remove the foreign material.

Fields with a history of homesteads, dumpsites, concrete ditches, and other condensed sources of foreign material should be identified. Scout those portions of the field for the risk of foreign material and flag and avoid planting if necessary. The owner of the field(s) may have historical knowledge of areas in the field that have higher amounts of foreign material.

Fields adjacent to golf courses, busy roadways, or near houses where homeowners routinely hit golf balls into the fields are at higher risk for containing foreign material. An additional commitment of routinely picking up trash from the sides of the roads and fields and/or looking for golf balls at harvest need to be factored in to the decision to lease the field.

Additional considerations regarding assessing and identifying solutions to minimize foreign material in leased fields can be found online at www.uidaho.edu/cals/potatoes/food-and-farm-safety.

Further Reading

Adjesiwor, A. T., and P. J. S. Hutchinson. 2021. *Know Your Herbicide-Resistant Weeds* (BUL 989). Moscow, ID: University of Idaho Extension. 2 p.

Hafez, S. L. 1997. *Sampling Procedure to Diagnose Nematode Infestations* (CIS 1056). Moscow, ID: University of Idaho Extension. 4 p.

Hafez, S. L., and M. Thornton. 1992. *Potato Nematodes and Their Control* (CIS 925). Moscow, ID: University of Idaho Extension. 4 p.

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BUL 1038 | Published January 2023 |