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## EC95-1249 Potato Production Stages: Scheduling Key Practices

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# Potato Production Stages: Scheduling Key Practices

**Alexander D. Pavlista, Extension Potato Specialist**



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Bolen, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources



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# Potato Production Stages: Scheduling Key Practices

Alexander D. Pavlista, Extension Potato Specialist

## Introduction

Characterization of potato growth and development is important for the scheduling of production practices, yield prediction and hail loss insurance. Most past descriptions emphasize above-ground vine growth, and neglect below-ground tubers. Recently, growth stages have been described integrating both vine and tuber growth, and relating some agronomic practices to them. This circular describes stages of potato production and indicates key practices at each stage (Table I). Norgold Russet, an early season potato grown in Scottsbluff, Nebraska (1989-90), was used as a model with planting on May 10 and subsequent plant development occurring chronologically in a desired production situation. For each stage or time period, key production practices and potato development events are described in the order shown in Table I.

## I. Pre-planting

*Most Critical Actions* = seed handling and preparation, fertilization.

*Key Biological Activities* = seed aging and dormancy.

This section deals with practices prior to planting.

## Production Practice:

Starter fertilizer may be applied prior to planting. A dry N-P-K (nitrogen-phosphorous-potassium) fertilizer mixture (18-46-0 is commonly used in Nebraska) may be broadcast and disced into the soil before planting. If used in home gardening, application at planting is recommended. Gardeners can break the ground with a hoe or shovel just prior to planting or have the area garden plowed. Pre-irrigation may be used to eliminate soil clods for ease of planting. A soil moisture of 70 to 80 percent field capacity is considered ideal for most soils.

## Seed-Cutting Practices:

During this period the main concern is to prepare the seed pieces for planting and avoid seed decay by diseases. In the United States, potatoes are not produced from true seeds but from tubers harvested the previous season. Nearly all production is from "seed pieces" cut from larger "seed-certified" tubers; some production is from "single drops" which are small whole tubers. Gardeners might want to use single drop seed if available and avoid some of the seed preparations otherwise recommended. All seed pieces should be about 2 ounces in weight (6 to 10 even-sized seed pieces per pound of whole potato tubers). Those less than 1 1/2 ounces should be discarded. Since seed tubers are stored at 36-40°F, they need to be warmed

Table I. Summary of potato production stages highlighting a Norgold Russet model<sup>1</sup>, key production practices and potato events.

Production Stage	WAP <sup>2</sup>	Date <sup>1</sup> (model)	Tuber <sup>1</sup> Development	Stem <sup>1</sup> Height	Production Practices	Potato Events
Pre-planting to Planting	< 0	May 10	—	—	seed preparation fertilization	seed aging
Planting to Emergence	0-3	May 31	rhizomes "hooking"	0 in.	weed control fertilization	sprout, rhizome and root growth
Emergence to Tuber Initiation	3-6	June 14 June 21	"swelling" "initiation"	5 in. 11 in.	early irrigation fertilization	vine, rhizome and root growth
Initiation to Tuber Bulking	6-8	July 5	< 1/2 oz.	14 in.	irrigation pest monitoring pest control	vine growth tuber initiation flowering
Tuber Bulking to Vine Senescence	8-14	July 19 Aug. 2 Aug. 16	1-2 oz. 2-8 oz. 8-11 oz.	15 in. 16 in. 16 in.	irrigation pest monitoring pest control	tuber growth
Vine Senescence to Harvest	14-20	Sep. 1 Sep. 21	9-12 oz. maturing	16 in. dead	disease control vine desiccation	vine death tuber maturity
Harvest and Storage	> 18	—	—	—	bruise avoidance storage management	bruise healing tuber weight loss tuber dormancy

<sup>1</sup> The model is Norgold Russet, an early-season russet-skinned variety, planted on May 10 at the Panhandle Research and Extension Center, Scottsbluff, Nebraska. This model represents a growing season of 134 days from planting to harvest (19 weeks after planting) or a vine and tuber growth season of 92 days (13 weeks) from emergence to vine kill (16 weeks after planting).

<sup>2</sup> WAP = weeks after planting [Emergence occurs about three weeks after planting.]

before planting. When a 40°F seed piece is planted in 50°F and wet soil, moisture will condense on the surface of the piece, creating an environment highly favorable for disease development. Cut seed pieces need to be warmed slowly and kept ventilated to allow for the formation of a protective, or suberin, layer over the cut surface.

At the time of cutting, treat seed pieces with a fungicide dust. This not only aids in drying the cut surface but also gives the seed pieces some protection against decay. Commercial growers using mechanical cutters need to disinfect the cutting blades between each lot of seed-tuber to prevent carryover of disease organisms from one lot to another. Homeowners who hand-cut seed, can dip a knife into a 10 percent Clorox solution between cutting washed tubers. Because dirt can inactivate the bleach, the solution should be changed often.

### **Plant Development:**

During storage, seed tubers were dormant. Toward the end of the storage period, dormancy ends and, to varying degrees, sprouting may begin. The tuber is the sole source of water and nutrition for the sprouts and the life activities within the tuber. Performance of seed pieces is greatly influenced by the tuber's physiological age, which is, in turn, affected by time, handling and storage conditions. Bruised seed tubers are physiologically older than non-bruised ones, and plants grown from these older seed pieces tend to emerge faster, have more stems, grow smaller vines, have more tubers per plant, bulk tubers quicker, die faster and yield less. Because of this growth pattern physiologically younger seed is preferred.

## **II. Planting to Emergence**

*Most Critical Actions* = weed control and fertilization.

*Key Biological Activities* = root, sprout and rhizome growth.

The planting to emergence period usually ends 3 weeks after planting and is lengthened by cooler soil conditions. This period ends when sprouts emerge from the soil surface.

### **Production Practices:**

Seed pieces should be planted 6 to 8 inches deep. Do not plant seed pieces in soil with a temperature less than 50°F. Soil moisture in the top foot should be between 65 and 80 percent field capacity. Irrigation during this period is not recommended as there is enough moisture and nutrition in a healthy and acceptably-sized (1 1/2-2 oz) seed piece to sustain the plant through emergence. Irrigation during this phase also may promote seed decay before emergence and early dying (Verticillium wilt) later when the tubers are rapidly enlarging.

Fertilizer can be applied during this period with nitrogen, phosphorus and potassium (N-P-K) added

as a side-dress 2 inches beside and at the same depth as the seed pieces. Row spacing is commonly between 32 and 36 inches. Recommended plant spacing within the rows varies with the intended market and variety; narrower spacing as low as 6 inches is adequate for seed tuber production while spacing as far as 16 inches is used for "bakers" and long french fries.

### **Pest Control:**

For commercial growers, a systemic insecticide may be added into the furrow during the planting operation but home gardeners should use foliar insecticide as needed during the season. In-furrow application involves placing the material after the furrow-opener and before seed piece placement. When properly done, some soil will cover the material before the piece falls due to the motion and vibration of the planter.

During this period, pre-emergence herbicide application is the most critical pest control operation. Most potato herbicides are labelled for pre-emergence application but are not recommended for post-emergence use on many potato varieties, especially white-skinned varieties, as they may be injured by the herbicide. Most pre-emergent herbicides used on potatoes have a 6 to 8 week active residual period in the soil. When applied at recommended rates around 2 weeks after planting, they will suppress weed growth until 5 to 7 weeks after emergence. By then, healthy plants should have closed the rows and the potato plants will keep down any newly emerged weeds by shading them. Cultivation is also used during this period as a mechanical weed control practice. By itself, cultivation has little residual effect and weeds will appear until row closure. Also, after some pre-emergent herbicide applications cultivation would have a negative impact by breaking the herbicide layer and throwing treated soil against newly emerged plants. The use of herbicides by home gardeners is not recommended for several reasons, including sensitive garden plants grown nearby, the small areas treated and possible exposure of pets and children. For home gardeners, the operative phrase is "a-hoeing we will go."

### **Plant Development:**

The seed piece is its own main source of food and water during this period and must be healthy from the start. After planting, the seed piece will sprout and grow toward the surface. Usually, more than one sprout will grow from a seed piece and often more than one stem will appear from a sprout. The additional stems from a sprout are actually branches.

During this period, plant resources are devoted to root and shoot growth. Potato roots tend to be relatively shallow. Rhizomes, or stolons as they are commonly but erroneously called, do not appear until around emergence. Rhizomes are the structures on which the next generation, or daughter tubers, will form.

### III. Emergence to Tuber Initiation

*Most Critical Actions* = disease and insect monitoring for treatment, gradually increasing irrigation and second application of nitrogen.

*Key Biological Activities* = healthy and rapid vine growth, root growth and development of tubers on the rhizomes.

Rapid vine growth, continued root growth and tuber initiation (enlargement at the ends of rhizomes) are the key characteristics of this stage. This growth stage lasts from emergence to pre-bloom, the period from 3 to 6 weeks after planting. This period is similar for short-end mid-season varieties but may be longer for long-season ones.

#### *Production Practices:*

Soil moisture should be at least 65 percent field capacity with 70 to 80 percent preferred. Therefore, irrigation can be infrequent in the beginning of this stage and intensified as plants grow larger. Additional applications of fertilizer, primarily nitrogen, also are made during this period.

In the early part of this stage, cultivation and hilling can be done. Remember, cultivation or hilling after placement of certain pre-emergent herbicides may interfere with their weed control activity as well as injure the plants. The roots are in the soil at the side of the hills and between the rows, care must be taken to avoid root pruning.

#### *Pest Control:*

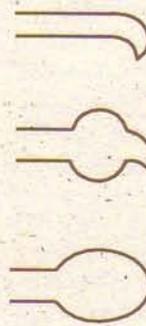
The use of herbicides labelled for early post-emergence application is not generally recommended due to possible injury to the plants at this stage. Under Nebraska's climate, there is minimal use of fungicides and insecticides.

#### *Plant Development:*

The major characteristic of this stage is rapid vine growth; the canopy may double in height every week for the first 3 weeks. Although the seed piece is a key food source early in this stage, food production (photosynthesis) increases as the foliage develops and grows until the leaves become the only food source.

Rhizomes, underground branches, will turn green and form leaves and secondary branches when exposed to light. From 3 to 6 weeks after planting, rhizomes are in the "hook" stage (Figure 1A), characterized by tiny leaves forming a hook-like appearance at the end of the rhizome. From the hook stage, the rhizomes go into the "swelling" stage, characterized by an oblong swelling that forms behind the hook and includes a slight "bowing" of the tip, giving the rhizome a "parrot" profile (Figure 1B). From the swelling stage, the rhizomes initiate tubers.

The duration of periods II and III depends on many factors, including planting date, variety, temperature, quality of seed piece and nitrogen fertilization.



A. "Hook" stage — Tiny leaves at the rhizome tips give a hook-like appearance; the girth of the rhizome is not enlarged.

B. "Swelling" or "parrot" stage — The tiny leaves remain at the rhizome tip; the rhizome tip swells oblong causing a slight bend.

C. "Initiation" stage — The tiny leaves at the rhizome tip are not visible; the swelling enlarges and rounds itself off forming an oval or spherical tip.

Figure 1. Stages and characteristics of rhizomes as tubers develop.

### IV. Tuber Initiation to Full Bloom and Tuber Bulking

*Most Critical Actions* = irrigation, and pest monitoring and early control.

*Key Biological Activities* = initiation of tubers and row closure.

As the name implies, tubers form during this stage. Tuber initiation covers the period from the rounding of the rhizome ends into spheroids and the appearance of most varieties first flowers to full bloom and the start of tuber bulking. For short-season varieties, this period is from 6 to 8 weeks after planting, or 3 to 5 weeks after emergence.

#### *Production Practices:*

Irrigation becomes increasingly important during tuber initiation due to high rates of transpiration (water movement within plant). Irrigation may also aid in common scab control. Optimum soil moisture is 80 to 90 percent field capacity. Except by commercial growers, fertilizer is not applied during the rest of the season. These growers may use petiole-nitrate analysis to indicate whether nitrogen in the plant have fallen below the suggested level for the variety being grown. Nitrogen, if required, needs to be added in small amounts through the irrigation system to maintain tuber quality. Excess nitrogen at this stage, however, may inhibit tuber initiation and could leach into the groundwater.

#### *Pest Control:*

Herbicide residual activity should last to the end of this stage when the rows close (that is, when plants in adjacent rows touch each other between the rows across the furrows). In comparison to many other potato production areas, foliar application of fungicides and insecticides is usually low in Nebraska. This may vary widely, however, based on the intended market. For instance, growing seed potatoes requires higher pesticide input than growing tablestock. Also, pesticide use varies greatly from year to year,

depending on weather conditions and pest infestations. In areas with high humidity and warm night temperatures, disease and insect problems are much more severe and occur earlier than in Nebraska, where the cold winters (-30 to -40°F), little snow cover and arid climate help to keep pest populations low.

#### **Plant Development:**

This stage is identified by the formation of tubers at the end of the rhizomes, which form when the tiny leaves at the end of the rhizome disappear and the tip becomes oval or spherical (Figure 1C). For a couple of weeks these tubers, although formed, grow very little while the vines continue to grow.

Toward the end of this stage, vine growth slows and the plant is in full bloom. Most varieties are determinate, meaning, vine growth ends with flowering. Some long-season varieties, most notably the Russet Burbank, are indeterminate and vines continue to grow after flowering. Potato plant flowers may be pollinated, producing small, round, green fruit containing true seed. Row closure also occurs during this stage, assuming healthy growth and sets the transition from vine growth to tuber growth or bulking.

### **V. Tuber Bulking to Plant Senescence**

*Most Critical Actions* = irrigation, pest control and stress avoidance.

*Key Biological Activities* = tuber growth.

This usually is the longest stage in potato growth, lasting from full bloom to senescence or vine death in determinate varieties. It extends from 8 to 14 weeks after planting (5 to 11 weeks after emergence) for early-season varieties; longer for later-season varieties.

#### **Production Practices:**

Because the plant has its highest demand for water at this time, the most important practice now is irrigation. Depending on rainfall, application of 1 1/2 inches per week, or a total of 12 to 15 inches during this stage is normal. Soil moisture needs to be kept between 80 and 90 percent field capacity. Because plant stress is critical, sprinkler irrigation also may help to cool the plants and soil in hot, dry climates.

#### **Pest Control:**

The key is to keep plants from becoming stressed. In many potato production areas, fungicides are applied to prevent early and late blight. In Nebraska, this is usually minimal. Irrigation may help minimize tuber blemishes due to common scab and black scurf. Sulfur can be applied through sprinkler irrigation to assist healing of vines after hail or when early blight is present. Late blight occurs seldom, once every 10 to 15 years, and early blight usually occurs toward the end of the season. A pre-harvest treatment of certain

fungicides will reduce tuber break-down in storage due to leak and other diseases. Diseases such as early dying, wilts and black leg cannot be chemically controlled but using certified seed and keeping the plants healthy usually will prevent them from being a problem.

The use of foliar-applied insecticides depends on insect populations. Often in Nebraska, an insecticide is applied only once during the middle or latter part of the season. Natural predators in Nebraska often keep the population of the Colorado potato beetle below injurious levels. The occasional migration of the potato leafhopper and green peach aphid (once in 4 to 5 years depending on the wind from the Gulf of Mexico) occurs relatively late in the season. Insect control is primarily important to the potato seed producer in Nebraska because of their potential for carrying plant viruses.

Weeds are not usually a problem after row closure. There are a few herbicides available for post-emergence use on potatoes.

#### **Plant Development:**

Growth during this stage is totally centered on the tubers, and final yield and quality depends on what happens here. The tubers will undergo a logarithmic growth pattern (Figure 2) which is characterized by a gradual growth increase, then a near doubling in size and weight ending with a gradual slowing of growth to a plateau level. During this period, the tubers are the food sink; sugars are transported from the leaves to the tubers and converted to starch. The transport of sugars in the reverse direction can occur if plants are under stress which may result in lower yields and poorer market quality. All plant stress should be avoided and so all steps should be taken to "keep them happy."

Except for indeterminate varieties, there should be no or little vine growth. Vine growth consumes nutrients at the expense of tuber growth.

### **VI. Plant Senescence to Harvest**

*Most Critical Actions* = vine desiccation.

*Key Biological Activities* = vine death and tuber maturity.

The two facets of this stage are vine and tuber maturation. It begins with vines showing the first signs of dying and lasts until harvest. In early-season varieties, this covers from 14 to 18 weeks after planting (11 to 15 weeks after emergence). For later varieties, this stage can come later and last longer.

#### **Production Practices:**

Little, if any, irrigation is needed during this stage; the soil moisture should be held between 60 - 65 percent field capacity, mostly to avoid clumping for easier harvest. No fertilizer should be applied; it may delay vine maturation and make desiccation more difficult.

The main practice in this stage is the use of desiccation techniques to hasten vine death. These can be chemical, mechanical or a combination of the two. The main purposes of desiccation are to promote tuber maturity, ease harvesting and minimize tuber infection by blight spores on the vines.

#### **Plant Development:**

From senescence to death, the leaves and branches turn yellow to brown and the leaves fall off.

From senescence to death to harvest, the tubers mature; their growth ends. Dry matter, especially starch, reaches a peak and the reducing sugars, specifically glucose, fructose, and sucrose, decrease to a low. The tuber skin hardens and thickens. These changes are promoted by vine death. Chemical vine desiccants are used to achieve complete and yet gradual (two to three weeks) death of vines. If death is too rapid, either by desiccation methods or frost, then the tubers do not mature as well and may develop internal defects.

## **VII. Harvest and Storage**

*Most Critical Actions* = bruise avoidance and storing tubers under the right conditions for their intended market.

*Key Biological Activities* = bruise healing, tuber dormancy, starch breakdown and metabolism.

After these production stages, the tubers need to be removed from the ground. If not marketed directly following harvest, they need to be stored.

#### **Tuber Bruising:**

A key concern in harvesting potatoes is tuber bruising. Types of bruises include cuts made by the harvester, shatter bruise and internal black spot, which develop from dropping tubers or impacting them against each other with force, and skinning resulting from rubbing of the tubers. An additional type, pressure bruise, can occur from piling tubers too high in storage. The severity of bruising is related to the maturity, temperature and hydration level of the tubers. Bruises will lead to several problems in storage and cuts and shatter are good entry points for diseases. All bruises will speed the aging of tubers and are related to seed performance. Internal black spot and pressure will discolor during cooking. Skinning will make an unattractive tablestock potato. Research continues to uncover negative effects of bruising.

#### **Storage Practices:**

Storage conditions are critical. Appropriate conditions vary depending on the intended market for the harvested potatoes. Conditions such as temperature, curing, and sprout control treatment may differ for potatoes to be marketed as seed or tablestock and for

those to be processed into potato chips or frozen potato products. Storage should be well ventilated to promote wound healing and inhibit condensation. Tubers are alive; they respire, take in oxygen and release carbon dioxide. Relative humidity should be about 95 percent to reduce tuber weight loss, but condensation needs to be avoided to minimize diseases. Seed and tablestock potatoes are usually stored at 36 to 40°F. Those to be used for frozen, pre-cooked, products are usually stored at 45°F while potatoes to be processed into potato chips are stored at 50°F to keep reducing sugars from accumulating in the tubers. For the chip and fry processing markets, and for some long-term tablestock storage, tubers are quite often treated with sprout inhibitors. Of course, these materials cannot be used on seed potatoes. For early planting of seed, sprout promoters are sometimes used. To inhibit dry rot a fungicide may be applied on tubers going into storage.

#### **Plant Development:**

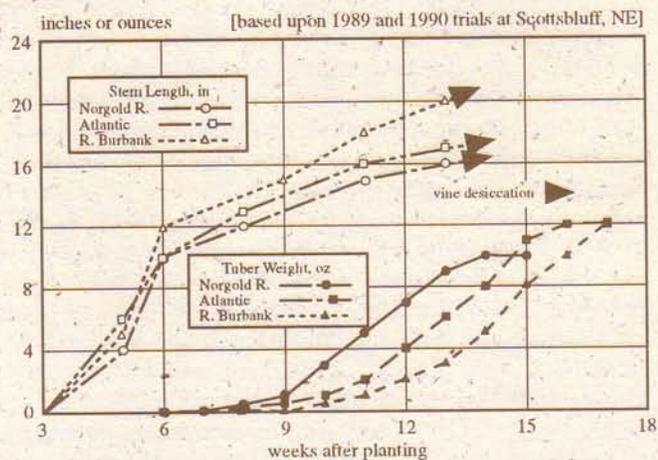
Stored tubers are dormant and will not sprout for some months. They are, however, very much alive! Sugars accumulate in potatoes under cold storage, since tubers do not burn-off (metabolize, respire) the sugars as rapidly as under warmer conditions. In addition to sprouting, warm storage temperatures favor disease development.

## **Model System Comparisons**

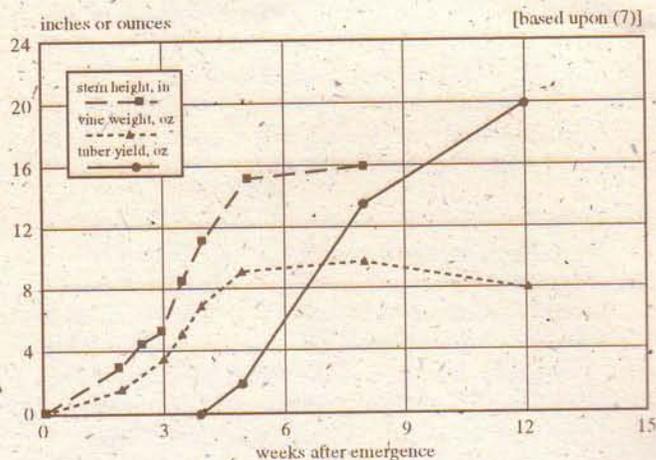
Norgold Russet, a short-season russet-skinned variety grown in the panhandle of Nebraska, is the model depicted in the timeline presented in *Table 1*. The growth of the stem and tuber of this variety are also shown in *Figure 2*.

A comparison of this early-russet model is made with Atlantic, a mid-season white variety and Russet Burbank, an indeterminate, long-season russet variety (*Figure 2*). Data were collected from russet varieties (Norgold Russet, Russet Norkotah, Russet Burbank, Hilite Russet and Krantz), white varieties (Atlantic, Monona, Norchip, Snowden and Wischip), and red varieties (Red Cloud, Red LaSoda and Red Norland). These varieties and their relative performance in Nebraska is described in Pavlista et al, 1992.

Potato varieties show similar growth patterns. That of the variety Superior, a short to mid-season white variety as grown in a greenhouse, is shown in *Figure 3*. Note that vine growth dominates during the first half of the season; tuber growth, the second. The basic logarithmic growth of the Norgold Russet variety is typical for a white-skinned mid-season variety such as Atlantic (*Figure 2*). Long-season, indeterminate varieties such as Russet Burbank show a continuous vine growth until cold weather or vine desiccation. The tuber growth still shows a similar pattern although later in the season (*Figure 2*).



**Figure 2.** Comparison of stem height (inches) and tuber weight (ounces) of early- (Norgold R.), mid- (Atlantic) and late-season (R. Burbank) varieties [based upon 1989 and 1990 trials at Scottsbluff, NE].



**Figure 3.** Stem height (inches), vine fresh weight (ounces) and tuber yield (ounces per plant) of the potato variety Superior grown in 12-inch pots under greenhouse conditions [based upon Pavlista, A.D. 1993. Morphological changes and yield enhancement of Superior potatoes by AC 243,654. *Am Potato J* 70:49-59.]

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<insert 1>

### Nitrogen - Phosphorous - Potassium (NPK) Fertilization Rates

Research conducted on many potato varieties in North America between 1939 and 1989 shows the following general observations:

Nitrogen * Rate, lb/acre	Effect on US#1 Yields	Effect on Percent Dry Matter Content
0 to 150	Increase	No Change
150 to 400	No Change	Slight Decrease
above 400	Decrease	Decrease

\* Ammonium nitrate effects dry matter content more than ammonium sulfate. For tablestock and home use, nitrogen fertilization is applied for yield because the effect on dry matter content is not important. Longer season varieties need more nitrogen to maintain a longer vegetative growth period. The dry matter content of chipping varieties is lowered by over fertilization with nitrogen.

Phosphorus * Rate, lb/acre	Effect on US#1 Yields	Effect on Percent Dry Matter Content
0 to 50	Increase	Slight Increase
above 50	No Change	No Change
0 to 100	Increases Large Tuber Sizes	

\* No differences were reported between superphosphate, diammonium phosphate and monoammonium phosphate. Excess phosphorus will not injure potatoes; the amount used depends on the economics of the market. Since interest is often centered on sizing for large potatoes for fries, tablestock or home use, more phosphorous is used than for potatoes going for seed or chips.

Potassium * Rate, lb/acre	Effect on US#1 Yields	Effect on Percent Dry Matter Content
0 to 80	Increase	Decreases
above 80	Increases Large Sizes	Decreases

\* Dry matter content is decreased most by potassium chloride, then by potassium nitrate and least by potassium sulfate. Since the increase in larger tubers is solely the result of water accumulation, potassium levels are kept low for chipping potatoes. For non-frying uses and long french fries, high amounts, 100 to 300 lb/acre, may be acceptable.

<insert 2>

### Important Pest Distribution in Nebraska

**Diseases:** Dry rot (*Fusarium*) was found to be the principle agent of seed decay which becomes more serious when healing of cut surfaces is delayed. Common scab is a growing concern in Nebraska. Wilts caused by *Fusarium*, *Rhizoctonia* and *Verticillium* are found in southern Nebraska. Early blight may be observed throughout the state and late blight appears near the end of the season about every 10 years. Detailed information on potato diseases is available from several excellent books.

**Insects:** In most years, insects are not a major problem in Nebraska. Potato seed producers are concerned about small populations of some insects such as aphids because they may carry plant viruses. Growers keep a watchful eye on the green peach and potato aphids, and the aster and potato leafhopper which may migrate into Nebraska on winds from the Mississippi Delta and eastern Texas. The Colorado potato beetle appears every year but the population is low, possibly due to the action of predators which are allowed to thrive by the lack of early-season foliar insecticide application. Usually "the beetle" appears only late in the season in any numbers since it overwinters poorly in the state. Damage is usually slight and occurs about two to four weeks before vine desiccation.

**Weeds:** Sandbur, a grass, is the major concern in Nebraska. Redroot pigweed is found in the Panhandle (West) and along the Platte River (South). Nightshade is a major weed concern in the West.

West	South	North	East *
<b>Diseases: **</b>			
blights	<b>Blights</b>	<b>Blights</b>	blights
<b>Common Scab</b>	—	common scab	common scab
<b>Seed Decay</b>	<b>Seed Decay</b>	—	seed decay
wilts	<b>Wilts</b>	—	?
<b>Insects: **</b>			
leafhopper	leafhopper	leafhopper	leafhopper
Col.pot. beetle	Col.pot. beetle	Col.pot. beetle	Col.pot. beetle
aphids	aphids	—	—
pot. psyllid	wireworm	—	—
<b>Weeds: **</b>			
<b>Sandbur</b>	<b>Sandbur</b>	<b>Sandbur</b>	<b>Sandbur</b>
<b>Redroot Pigweed</b>	<b>Redroot Pigweed</b>	—	—
<b>Nightshades</b>	—	—	—

\* East — Most growers in this area are under 20 acres; the information used here is mostly from growers in the northeastern part of the state.

\*\* Pests indicated in bold are considered important concerns in the region while those in lower case letters are minor concerns.