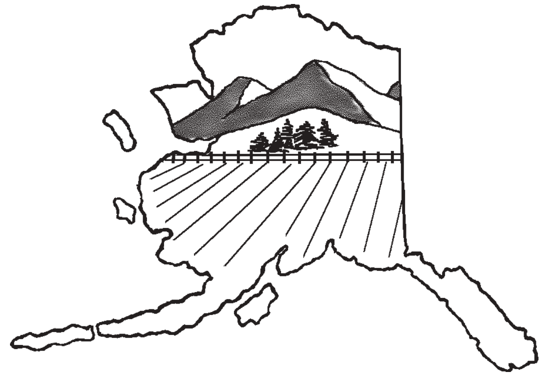
Crop Production
and
Soil Management Series



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Field Crop Fertilizer Recommendations For Alaska

POTATOES

by
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CONTENTS

Successful potato production depends on numerous factors that can be controlled by the grower. Among these are variety, seed quality, seed size, plant population, moisture supply, soil compaction, pest incidence, dates of planting, hilling and harvest, as well as fertility management. These factors interact in such a way that examining any single factor simplifies a very complex system. For example, fertilizer recommendations will vary depending upon overall yield potential that may be determined by potato variety, available water, weed population, or other yield components. The fertilizer recommendations in this guide reflect optimum management of all non-fertility yield components. These recommendations should result in maximum tuber production permitted by environmental conditions in Alaska.

SOIL ACIDITY

Soil pH must be carefully controlled to avoid loss of tuber quality through common scab *(Streptomyces scabes)* infection. This pathogen invades growing tubers through lenticels or wounds and causes lesions on the tuber surface that may render the tuber unmarketable. While potato varieties vary in susceptibility to common scab, all varieties are more adversely affected as soil pH rises. (Common scab infection is also increased when young, actively growing tubers are subjected to water stress.) Recommendations for soil pH in potato production are based less on conditions optimal for potato growth than on minimizing the risk of infection by common scab. Soil pH should be kept between 5.0 and 5.4.

NITROGEN

The nitrogen (N) requirement of potatoes is dependent upon the variety. Nitrogen source is not considered to be critical for potatoes, as long as management is suitable for the chosen fertilizer source (for example, urea should be incorporated rather than applied to the soil surface). If organic sources of N are used, release rates must be rapid enough to provide adequate N for the growing potato plant.

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For the purpose of N requirement, varieties can be grouped into those with russetted and non-russetted skins. Most of the potatoes grown in Alaska have non-russetted skins and are categorized as white or red skinned potatoes. These include Bake-King, Green Mountain, Iditared, Kennebec, Shepody, and Superior. For these varieties, all N is generally applied at the time of planting, and may be banded or broadcast. Banded fertilizers should be placed at least 2 to 3" from the seed piece. Approximately 80 to 100 lb N/a is satisfactory for production of white and red skinned varieties in Alaska.

This is about one-half of the rate recommended for other potato producing areas. This is because the yield potential in Alaska is restricted by the length of the growing season and due to lower levels of irrigation in Alaska that reduces chances for N fertilizer loss.

Russetted potato varieties such as Acadia Russet, Allagash Russet, Columbia Russet, Frontier Russet, Lemhi Russet, and Russet Norkotah have higher N requirements. These varieties benefit from N applications that total about 120 lbs N/a. Where residual N is determined by spring soil sampling, soil plus fertilizer N should not exceed 175 lbs N/a. Although yield increases are noted with split N applications on Russets, the yield responses are small. For the varieties listed, a preplant incorporated application is appropriate.

In all potato varieties, the specific gravity of the harvested tubers will decrease as the rate of applied N increases. Therefore, where high specific gravity tubers are desired, it is important to limit N application to the minimum needed by the crop.

PHOSPHORUS

Phosphorus (P) utilization is affected by soil conditions, including both the past fertilization history of the soil as reflected by the soil test P level, and by soil mineralogy. Soils testing high in P require a lower fertilization rate than those with a low test level. Additionally, soils with high capacities for “fixing” or immobilizing P may require higher rates of P to overcome this fixing capacity. Two soil types in Alaska that have high P fixing capacity are volcanic ash soils (including the Kachemak, Kashwitna, Naptowne, Rabideux, and Tustumena series) and alkaline soils of Interior Alaska.

Table 1 is based on using highly soluble P sources such as triple super phosphate, ordinary or single super phosphate, mono- or diammonium phosphates, or similar materials. If materials with slowly available P, such as rock phosphates, or some other organic sources are used, application rates will usually have to be adjusted upward. The recommended application rates are for the soil test listed just above each recommendation. All recommendations are in lbs of P_2O_5 per acre. For soil test values between those listed, interpolate from the values in the table. For example, a Kenai soil testing 20 ppm P (halfway between the very low and low categories) would require about 280 lbs P_2O_5 per acre (half-way between 240 and 320).

Phosphorus fertilizers are usually applied at or before the planting time. Phosphorus may be broadcast uniformly and incorporated into the soil or banded with the potato planter. Fertilizer bands should not be in contact with the potato seed-piece, but should be placed at least 2" away. Phosphorus availability is low in cold soils; therefore providing adequate P early in the growing season is critical for good growth during this time.

POTASSIUM

Two major sources of commercially available K fertilizer are potassium chloride (KCl) and potassium sulfate (K_2SO_4). Both of these materials are highly soluble; either provides an adequate source of K for potatoes. Potassium chloride is usually less expensive, although potassium sulfate may be preferred in some cases. The use of potassium sulfate will often (but not always) result in tubers with higher specific gravity than those grown with potassium chloride. Additionally, where salt buildup is a problem, or when salt-sensitive crops will follow potatoes, potassium sulfate may be preferable due to its lower salinity.

Potassium may be applied prior to or at planting. Either band or broadcast K applications should provide satisfactory results. Table 2 shows recommended K rates by soil test K level.

Table 1. Recommended phosphorus application rates for potatoes.[1]

Soil Series	Soil Test Category [2]	Very Low	Low	Medium	High	Very High
Cohoe, Island, Kenai, Naptowne, Soldotna, Tustumena	Soil Test (ppm)	4	35	66	97	128
	lb P_2O_5 to Add/a	320	240	160	80	0[3]
Beluga, Kachemak, Mutnala	Soil Test (ppm)	4	55	107	158	209
	lb P_2O_5 to Add/a	320	240	160	80	0[3]
Bodenberg, Doone, Knik, Matanuska, Niklason, Susitna, Homestead	Soil Test (ppm)	43	70	96	123	150
	lb P_2O_5 to Add/a	320	240	160	80	0[3]
Beales, Chena, Fairbanks, Gilmore, Goldstream, Nenana, Steese	Soil Test (ppm)	6	61	115	170	225
	lb P_2O_5 to Add/a	200	150	100	50	0[3]
Jarvis, Richardson, Salchaket, Tanana, Volkmar	Soil Test (ppm)	6	39	72	106	139
	lb P_2O_5 to Add/a	200	150	100	50	0[3]

[1] From Michaelson & Ping, 1989.

[2] Mehlich 3 extraction.

[3] When soil P tests are at the very high level and above, it is generally recommended that a small amount of P (about 50 lb P_2O_5/a) be applied as a starter fertilizer to provide adequate nutrition in cool soils.

Table 2. Recommended potassium application rates for potatoes.

Soil Test Level[1] (ppm)	Recommended Application Rate
	lb K_2O/a
0 - 75	180
76 - 150	120
151 - 300	60
Over 301	0

[1] Mehlich 3 extraction.

SECONDARY AND MICRONUTRIENTS

Applying secondary nutrients (magnesium (Mg), calcium (Ca), sulfur (S)) for potato production in Alaska is seldom required. Deficiencies of these nutrients are most likely to occur on well-drained sandy soils. Adequate S will almost always be provided if sulfate salts of K or N are used. Problems suspected to be caused by lack of secondary nutrients should be confirmed with analysis of soil and plant tissue samples. (See Cooperative Extension Service (CES) Publication FGV-00043, *Soil Sampling and Analysis*, and CES Publication FGV-00243D, *Plant Tissue Testing*). If these nutrients are found to be lacking, they may be broadcast or band applied prior to or at the time of planting (Table 3). Although Ca and Mg may be supplied through adding calcitic or dolomitic lime, these sources usually are not preferred for potatoes because they raise soil pH. Lime should only be considered if soil pH is below 5.0.

Supplemental additions of micronutrients (boron (B), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), zinc (Zn)) are seldom needed for production of potatoes in Alaska. If the pH is kept in the proper range for potatoes, (5.0 to 5.4) Cu, Fe, Mn, and Zn availability will be adequate. If problems occur with these nutrients, the soil pH probably requires readjusting. Micronutrient deficiencies should be confirmed by soil and plant tissue analysis. Table 4 shows recommended micronutrient application rates. Please note that over-applying micronutrients can cause plant damage.

PLANT TISSUE SAMPLING

Tissue samples may be collected from potatoes at various times during the growing season. Either the youngest mature leaf or petioles (leaf stems) associated with those leaves may be collected, depending on time of the season (Table 5). When collecting leaf samples, the petioles should not be included. Petioles are often sampled for analysis of soluble nutrients (nitrate-N, phosphate-P, K) because this is the conducting tissue where nutrients travel from the stem to the leaf, and may provide a more sensitive test for these nutrients than leaf analysis.

Table 3. Sources and recommended secondary nutrient application rates for potatoes.

Nutrient	Sources	Recommended Application Rates
Calcium	gypsum ($CaSO_4$)	100-500 lb Ca/a if broadcast; 20-50 lb Ca/a if banded
Magnesium	epsom salts or kieserite ($MgSO_4$), sulfate of magnesium potash or sulpomag ($K_2SO_4 \cdot 2MgSO_4$)	50-100 lb Mg/a if broadcast; 10-20 lb Mg/a if banded
Sulfur	elemental sulfur[1], epsom salts, gypsum, sulpomag, ammonium sulfate ($(NH_4)_2SO_4$), potassium sulfate (K_2SO_4)	25-100 lb S/a

[1] Elemental S should never be banded. As a broadcast treatment, 1000 lb of elemental S/a will reduce soil pH between 1 to 2 units.

If a field contains both healthy and unhealthy plants, collect samples from both the healthy and unhealthy plants, making sure that the same plant part is taken in both cases. The healthy plant can be used as the standard value against which the unhealthy plant is compared.

Plant tissue samples should be collected from plants representative of the sampling area. Dead or damaged plants, those with insect or disease problems, at the end of rows or in edge rows, or plants that differ significantly from those in the rest of the planting should not be sampled. Avoid plants that have been recently sprayed with foliar fertilizers.

Table 4. Sources and recommended micronutrient application rates for potatoes.

Nutrient	Sources	Recommended Application Rates
Boron	borax, solubor	1 lb B/a
Copper	copper chelates, copper sulfate ($CuSO_4$)	1-2 lb Cu/a banded; or 4-8 lb Cu/a broadcast
Iron	iron sulfate ($FeSO_4$)	2.5-7.5 lb Fe as $FeSO_4$/a in 20 gallons water applied foliarly
Manganese	manganese chelates, manganese sulfate ($MnSO_4$)	3 lb Mn as $MnSO_4$/a or 0.5 lb Mn/a as Mn chelate banded; or 1 lb Mn in 20 gallons water applied foliarly
Molybdenum	sodium or ammonium molybdate	0.5-5 oz Mo/a broadcast; or 0.5-1.0 oz Mo/a in 20 gallons water applied foliarly
Zinc	zinc chelates or zinc sulfate ($ZnSO_4$)	0.5-1.0 lb Zn as chelate or 2-4 lb Zn/a as $ZnSO_4$ banded; or 1-2 lb Zn as chelate or 4-8 lb Zn/a as $ZnSO_4$ broadcast; or 0.15 lb Zn as chelate or 1 lb Zn/a as $ZnSO_4$ applied foliarly in 20 gallons water

Table 5. Recommended plant part and stage of growth for potatoes.

Number of Plants	Plant Part	Stage of Growth
25	Youngest mature leaf	Plant 12 in tall
25	Youngest mature leaf	Tubers $^1/_2$ grown
25	Petiole of 4th leaf from the growing tip	Early, mid, or late season

Try to sample clean leaves. Wash leaves only if they are to be analyzed for iron or aluminum. Wash quickly in a mild (2%) detergent solution, if required. Dry fresh tissue samples rapidly at 150 to 175 ℉ until all water is removed. Drying at higher temperatures may destroy plant tissues; drying at lower temperatures will not stop biological activity. Tissue samples will dry best in open containers, cloth bags, or opened paper bags. Samples should be dried immediately following sampling. If this is not possible, samples may be refrigerated for short periods of time before drying.

Nutrient analyses can be compared to the values in Tables 6 and 7 to evaluate the nutritional status of sampled plants. Unless nutrients can be applied through irrigation, it will often be impossible to correct nutritional problems in the growing season the samples were collected. However, the nutritional information from tissue analyses should be used to adjust fertility practices in subsequent years.

Table 6. Standard nutrient values for potato leaves.

Nutrient	12 inch plants	Tubers $^1/_2$ grown
Nitrogen (%)	4.50 - 6.5	3.00 - 4.00
Phosphorus (%)	0.29 - 0.50	0.25 - 0.40
Potassium (%)	2.40 - 3.90	3.20 - 4.10
Calcium (%)	0.76 - 1.00	1.50 - 2.50
Magnesium (%)	0.36 - 0.49	0.49 - 0.54
Boron (ppm)	25 - 50	40 - 70
Copper (ppm)	7 - 20	7 - 20
Iron (ppm)	50 - I00	40 - 100
Manganese (ppm)	30 - 250	30 - 250
Zinc (ppm)	45 - 250	30 - 200

Table 7. Sufficiency levels for nitrate-N, phosphate-P, and potassium in potato petioles.

Stage of Growth	Plant part	Nitrate-N (ppm)	Phosphate-P (ppm)	Potassium (%)
Early-season	Petiole of 4th	>19000	>2000	>12.0
Mid-season	leaf from the	>15000	>1600	>9.0
Late season	growing tip	>8000	>1000	>6.0

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