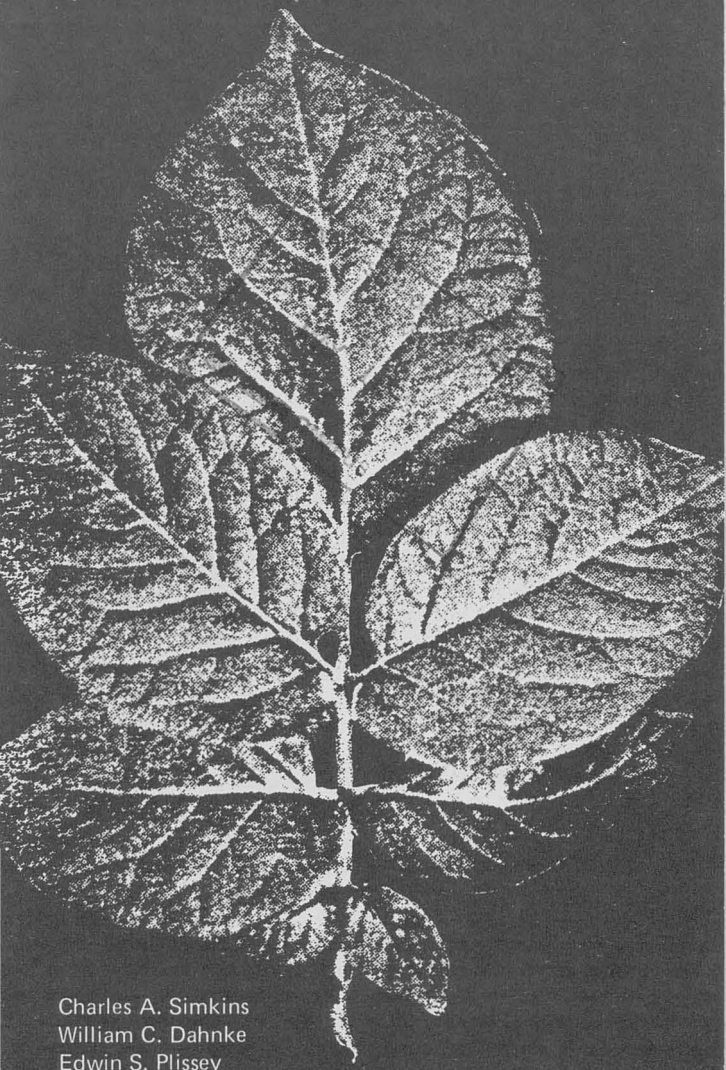
1. Minnesota Extension Service

Extension Folder 296
1974

Fertilizer for Potatoes

MN2000EF 296

in Minnesota's and North Dakota's Red River Basin



Charles A. Simkins
William C. Dahnke
Edwin S. Plissey

AGRICULTURAL EXTENSION SERVICE
UNIVERSITY OF MINNESOTA

The Red River Valley of Minnesota and North Dakota has climatic and soil conditions permitting production of high yield, good quality potatoes. Although there are many cultural practices which influence potato production, proper use of fertilizer can assist the potato grower in setting the stage for high yields of salable potatoes.

Yield Potential for Potatoes in the Red River Valley

High yields and high quality potato crop production are possible only with a relatively high available moisture level in the soil during the growing season. Precipitation of 14-15 inches, which is normally received in the Red River Valley during the growing season, provides sufficient moisture to produce yields of 250-300 hundredweight (cwt) of marketable potatoes per acre on the fine-textured soils. Potatoes grown on coarse-textured (sandy) soils without irrigation generally yield less than 200 cwt per acre. Potatoes grown under irrigation can yield more than 400 cwt per acre. Studies indicate that about 18 inches of water is the average seasonal use for potatoes in the Red River Valley.

In determining fertilizer use, the potato grower should establish a realistic yield goal based on management, and soil and moisture conditions.

Influence of Fertilizer Use on Potato Quality

The market quality of potatoes is closely associated with yield. Optimum growth usually means good quality. With deficient plant food levels, the small size potatoes produced are unacceptable to the market. Then, too, overuse of fertilizer can produce oversize tubers with hollow heart and low starch content. Improper fertilizer use can result in potato immaturity, making them more susceptible to excessive bruising and skinning. Fertilizer which is applied according to soil test levels and plant nutrient requirement will help insure quality production.

Nutrient Uptake of Potatoes

Although there are definite differences in the growth period of various varieties of potatoes, the normal time from planting to harvest is from 100 to 120 days. Approximately 1 month is required for plants to emerge after planting seed pieces.

Foliage growth is rapid during the first month following emergence and about 10 percent of the total nutrients are absorbed during this period. During the last month of growth, most of the accumulation of nutrients occurs in the tubers. Growth rates of more than 20 cwt per day have been measured.

Figure 1 shows the nutrient uptake of potatoes from 30 to 110 days after planting.

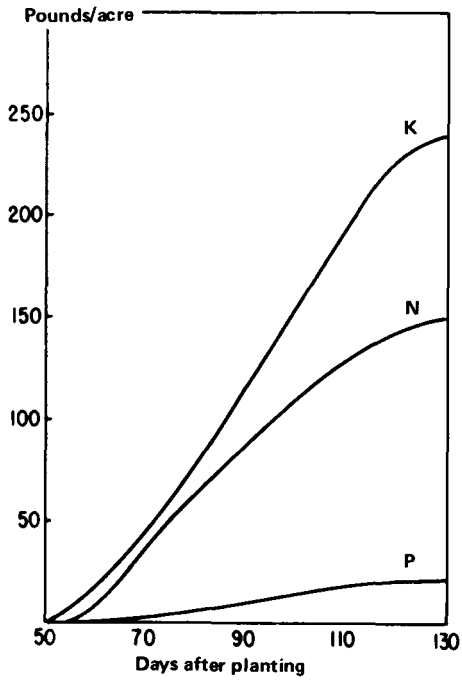


Figure 1. Uptake of nutrients by potatoes

The potato crop has a relatively high requirement for plant nutrients. From 25 to 30 percent of the plant nutrients are in the vines. There is a high requirement for potassium — the largest portion going to the tubers. Table 1 shows typical amounts of plant nutrients in the vines and tubers of a mature potato crop of 400 cwt.

Table 1. Plant food in potato crop (400 cwt yield)

	Pounds		
	N	P	K
Tubers	110	15	155
Vines	40	5	75
Total	150	20	220

Figure 2 illustrates potato growth compared with total plant growth and tuber development. During the first 50 days after planting, most of the weight of the potato plant is vine. Near maturity, two-thirds of the total plant weight is in the tubers.

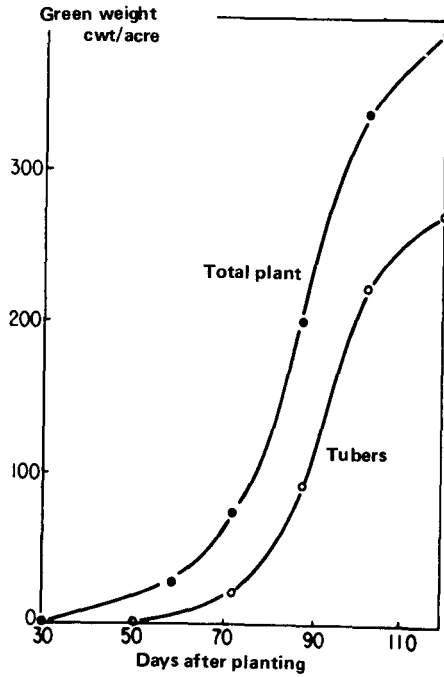


Figure 2. Potato growth

Nitrogen Fertilizer Use for Potatoes

Nitrogen promotes the vegetative growth of potatoes. Ideally, enough nitrogen should be applied to promote good vine growth, but the supply should be exhausted later in the season to insure maturity.

Too little nitrogen will result in reduced vine growth, light-colored foliage, and poor yields. Too much nitrogen will make potato vines difficult to kill and tubers will be low in dry matter and subject to bruising and skinning.

A nitrate nitrogen soil test before planting potatoes can be of great value in determining the available nitrogen supply of the soil and the need for additional nitrogen fertilizer. A composite sample taken from a depth of 0-24 inches in 15-20 locations within a field should make up the soil sample to be tested for NO_3-N.

Table 2 shows the amount of nitrogen to apply for the potato crop based on yield goal and NO_3-N test to a depth of 2 feet.

Table 2. Nitrogen fertilizer recommendations for potatoes based on NO_3-N test at 2 foot depth

Yield goals potatoes cwt/acre	Values below MINUS NO_3-N test equal pounds N fertilizer to apply per acre
200	100
300	150
Irrigated	
400	200
500	250

Nitrogen can be applied broadcast before or after seedbed preparation, or with the planter at planting time, or sidedressed shortly after potato plants emerge. Little benefit is derived from applications made 6 weeks or more after emergence. Late applications of nitrogen can cause second growth, knobby tubers, and tubers of low specific gravity.

Forms of Nitrogen for Potatoes

All forms of nitrogen can be used for potato production, but under certain conditions some forms may be more desirable than others.

Dry fertilizer materials can be applied whenever tractor or truck-mounted spreaders can be driven on the soil. Liquid nitrogen fertilizer materials without free ammonia may be sprayed on the surface of the soil before planting or sidedressed after planting. If urea is one of the nitrogen sources, some losses may occur in the high pH soils of the Red River Valley if applied and left on the soil surface. On irrigated potatoes, nitrogen may be applied in the irrigation water. Little benefit is derived from applications made later than 6 weeks after emergence.

Anhydrous ammonia, when properly used, can be an excellent source of nitrogen for potatoes. However, it can be quite toxic and must be applied with caution. Preplant applications should be made a week in advance. When sidedressed, it should be injected into the soil 6 inches deep and 6 inches from the plant row. Anhydrous ammonia sidedressed should be applied as soon as possible after plant emergence.

Phosphorus Fertilizer for Potatoes

The phosphorus need of potatoes is most often observed during the cold spring months. Too little phosphorus results in reduced vine growth, dark green foliage, and reduced tuber size. A good soil phosphorus level is essential in producing good quality potatoes.

Researchers indicate that potatoes are poor feeders for phosphorus. Less than 18 percent of the phosphorus fertilizer applied is recovered in the first year.

Phosphorus fertilizer should generally be applied at planting and placed close to the seed piece, but not in contact with it.

Phosphorus needs of the potato crop should be determined by soil test. The soil sample should be taken from the surface layer (0-6 inches). Table 3 shows the amount of phosphorus fertilizer to apply for potatoes at various soil test levels.

Table 3. Phosphorus fertilizer for potatoes

Yield goal cwt/acre	P_2O_5 lbs/acre to apply at various soil test levels (ranging from very low to very high)				
	VL	L	M	H	VH
200	120	90	60	30	25
300	160	110	80	40	25
Irrigated					
400	200	150	100	50	25
500	240	180	120	60	25
$P_2O_5 \times .44 = P$					

Phosphorus Sources

A phosphorus source used for potatoes should contain at least 60 percent of the total phosphorus in the water soluble form.

Normal super phosphate, treble super phosphate, and high analysis super phosphates are considered to be highly water soluble (about 80 percent). Ammonium phosphates and diammonium phosphates are most readily water soluble (90-100 percent). Ammonium polyphosphate fertilizers are also good sources of phosphorus for potatoes. *Ammoniated* super phosphates however, vary in their water solubility and can be as low as 20 percent in water solubility. This is also true of nitric phosphates.

Potassium Fertilizer for Potatoes

Although most fine-textured soils of the Red River Valley are relatively high in potassium, highest yields are usually obtained when some potassium fertilizer is added. Under conditions of high soil potassium, an application of 50 pounds of K_2O per acre is usually sufficient for maximum yields. Soils low in potassium may require 300 pounds K_2O per acre.

Soil tests to determine potassium level should be made on a composite sample taken from the surface layer (0-6 inches). Table 4 indicates the rate of potassium to apply, based on the soil test level and yield goal.

Sources of Potassium

Experimental results indicate that use of the sulfate form of potassium may result in a slight increase in the dry matter of potatoes when compared with the chloride sources. Yield responses to the two sources show little difference. Under Red River Valley conditions, where potassium additions are usually 100 pounds of K_2O per

acre or less, potassium chloride does not generally result in a reduction in the specific gravity of potatoes. The least expensive source of potassium fertilizer should be the most important consideration in potassium use.

Table 4. Potassium fertilizer for potatoes

Yield goal potatoes cwt/acre	Potassium to apply K_2O per acre for various soil test levels (ranging from very low to very high)				
	VL	L	M	H	VH
200	100	50	50	50	0
300	200	100	50	50	0
Irrigated					
400	300	200	100	50	50
500	400	300	200	100	50
K_2O x .83 = K					

Micronutrients

Studies with the use of micronutrients in the Red River Valley have shown no response in potato yield or quality. Potato growers should exercise care in use of micronutrients. The use of some micronutrients at rates as low as ½ pound per acre can decrease yield. A grower suspecting micronutrient deficiencies should use micronutrients only on a trial basis.

Method of Fertilizer Application for Potatoes

The best placement of fertilizer for potatoes has been found to be about 2 inches to the side and 2 inches below the seed piece. To do this, the fertilizer material is usually applied with the planter at planting time.

Fertilizer applied prior to planting with a row marker which allows for placement of a fertilizer band directly below the seed piece has given good results.

Spray applications of nitrogen fertilizer on growing potato plants has been less efficient than the same amount applied to the soil.

UNIVERSITY OF MINNESOTA
3 1951 D01 928 579 H

Charles A. Simkins is professor and extension specialist, Soil Science; William C. Dahnke is associate professor, Soils, North Dakota State University, Fargo; and Edwin S. Plissey is associate professor and area extension agent, Potatoes, East Grand Forks, MN. University of Minnesota and North Dakota State University personnel cooperated to produce this publication.

Use of commercial names does not imply endorsement nor does failure to mention a name imply criticism.

Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roland H. Abraham, Director of Agricultural Extension Service, University of Minnesota, St. Paul, Minnesota 55101.