

Foliar Fertilization Bumps Potato Yields in Northwest

Rate and timing of application, plus host of other considerations, are critical in applying foliar fertilizers to potatoes.

Summary: Results from these research trials would indicate that foliar fertilization has potential for an important role in potato production. Several new considerations, such as cost of fertilizer materials, concern for ground water quality, availability of new formulations of compounds, newer surfactants that increase efficiency of foliar absorption, etc., are factors that give reason to consider this fertilization method. Foliar fertilizer materials can be one more tool, along with soil-applied fertilizers, soil tests, and petiole analyses, to fine-tune fertility programs to maximize both quantity and quality of potatoes produced.

One of the first questions pertaining to the use of foliar fertilization is: can fertilizer nutrients be absorbed through leaves and stems? It has been established in various research studies that plant leaves and other above-ground parts are capable of absorbing chemicals and nutrients. Absorption of nutrients by plants is not a function limited to the root system.

In recent years, there has been renewed interest in the use of foliar fertilizers on potatoes and other crops. The renewed interest is largely due to the availability of new fertilizer formulations, which appear to be more suitable when used in this manner.

Applying macro and micro nutrients to the foliage of plants is not a new practice. It has been used on commercial fruit and vegetable crops for more than fifty years. However, there is limited research information on the commercial application and use of foliar nutrients on potatoes.

All of the macro and micro plant nutrient elements that contribute to plant growth and development, as well as the functional and metabolic processes that go on in plants, are listed in Table I. A deficiency of any one element will adversely affect and limit the entire metabolic system. On the other hand, toxicity levels and antagonistic relationships of nutrient elements can also occur in plants and cause detrimental results.

This article will present results of some of our research, the general aspects of foliar fertilization, and factors affecting uptake as well as use of foliar nutrients.

Setup

Objectives of our field trials have been to:

- evaluate the effect of foliar macro and micro nutrient applications on tuber yield (external and internal quality)
- determine effect on growth and various physiological parameters in potato

- evaluate interactions of plant/soil/water levels and foliar treatments.

Foliar nutrient applications were evaluated for four years on commercial potato fields in the Pasco, Warden, and Quincy areas of the Columbia Basin. These general evaluation trials were located on grower fields for actual commercial conditions under center pivot irrigation systems.

Cultural, fertilization, and management practices were those normally used by each grower, except for foliar spray applications in our plots. Thus, these treatments were in addition to the grower's planned fertilization program.

Sprays were applied at the rate of 20 gal/A, or at label rate if specifically stated otherwise.

Plots consisted of paired rows 40 feet long, with a guard row on each side.

Treatments were arranged in a randomized complete block design with six replications for statistical analyses.

Russet Burbank was the cultivar used in all trials.

Foliar fertilizers prove worth

Table 2 shows the commercially available foliar compounds that were tested and compared with an untreated control each year. The table also indicates the rate and time of application of the foliar sprays.

Materials were selected to provide either a fairly complete application of most of the nutrient elements, or single elements.

The usual harvest data were obtained in all trials including total yield, and yield of No. 1s and 2s in various size

Table 1. Macro and micro nutrient elements required for plant growth and metabolic processes in plants, Hiller, Washington State University.

MACRO	MICRO
Nitrogen	Boron
Phosphorus	Copper
Potassium	Iron
Calcium	Manganese
Magnesium	Molybdenum
Sulfur	Zinc

Table 2. List of foliar fertilizer treatments in grower/cooperator field trials, Hiller, Washington State University.

Treatment No.	Foliar Compound	Amount/A	Timing
1	Leaf Life B	1 qt	TI, TI + 2 weeks
	Leaf Life Mg	1 qt	TI, TI + 2 weeks
	Leaf Life Super		
	Zn 10	1 qt	TI, TI + 2 weeks
2	NutraPhos	5 lbs	TI
	Sorba Spray CaB	1 qt	TI
	Sorba Spray Mg	1 qt	TI
	NutraPhos	5 lbs	TI + 2 weeks
	Sorba Spray CaB	1 qt	TI + 2 weeks
	Sorba Spray Mg	1 qt	TI + 2 weeks
3	S & A High Yield	10 lbs	TI, TI + 2 weeks
	S & A High Phos	10 lbs	TI + 4 weeks
4	Leaf Life Mg	2 qt	TI, TI + 2 weeks
5	Leaf Life B	2 qt	TI, TI + 2 weeks
6	Thio-Sul	1 qt	TI, TI + 2 weeks
7	FMC Zn	3 qt	TI, TI + 2 weeks
8	Sorba Spray Ca	2 qt	TI, TI + 2 weeks
9	Sorba Spray CaB	2 qt	TI, TI + 2 weeks
10	Control (water)		TI, TI + 2 wks, TI + 4 wks
TI = Tuber Initiation			

Table 2. Average yield increase from foliar applications on potatoes in four-year study (1986 through 1989) in grower/cooperator fields, Hiller, Washington State University.

Year	Yield Increase Over Check	
	Total cwt./A	No. 1s cwt./A
1986	48.0	42.0
1987	9.0	24.6
1988	13.7	16.2
1989	54.0	48.0
4 year average	31.2	32.7

categories, specific gravity, and external/internal quality.

As shown in Table 3, foliar applications produced “total” yield increases over check that averaged 31.2 cwt./A over four years, and yield increases in “No. 1s” that averaged 32.7 cwt./A over four years. As can be seen, the years 1986 and 1989 produced the best increases during the four years of trials.

Results from our trials are encouraging and indicate the potential foliar fertilization has in the role of potato production. Lending further impetus to the new methodology are concerns for ground water quality, cost of fertilizer materials, new formulations available, and new surfactants that promise increased efficiency of foliar absorption.

Use care

There are a number of factors to consider in the application and use of foliar nutrients:

Application rate. Too much of certain nutrient elements can cause leaf burn, be wasted, or be toxic.

Time of day. For optimum absorption by plants, it is generally recommended that application take place early in the morning or late in the evening. It is further recommended that application not be made during midday, except during cool and cloudy weather.

Growth stage. It is generally agreed that these compounds should be applied early in the growing season. However, there is now information to show possible benefits of later applications during the tuber-bulking or tuber-maturing stages.

Droplet size. Droplet should be as fine as possible and achieve uniform wetting of leaf surfaces during application.

Weather. Apply foliar sprays only when there is adequate soil moisture. Do not apply to plants in a moisture-stressed condition.

Balance. Apply only what the plant needs. If there is not a low level on any one nutrient, a balanced formulation would be preferred.

Solubility of nutrient elements in solution is important to increase absorption by the foliage and prevent injury. Solution pH has an effect on solubility of nutrient elements, but if too low or too high, may be toxic to the foliage.

Not a substitute

The major benefits generally given for the use of foliar nutrient application

on potatoes are increased yields (preventing yield losses) and improved quality. Foliar-applied nutrients taken up by plants and increased concentrations can indeed be a benefit to plants. Foliar nutrition is ideally designed to provide many elements to a crop that may be limiting production at a time when nutrient uptake from the soil is inefficient or nonexistent.

While there is ample evidence to indicate that the mechanisms of foliar absorption and translocation largely resemble those of root absorption, foliar fertilization is not a substitute for soil-applied fertilizers.

Dr. Hiller is professor in the Department of Horticulture and Landscape Architecture at Washington State University.