Foliar Nutrient Application to Grass Grown for Seed[1]

John Hart (Professor), Donald Horneck (Assoc. Professor), Richard Roseberg (Assoc. Professor), all Crop & Soil Science Dept.; and Tim Righetti (Professor) Horticulture Dept., Oregon State University.

Nutrients can be absorbed or “taken up” by plants either through roots or leaves. The primary route for nutrients to enter plants is through roots. For nutrients such as nitrogen and potassium, foliar application cannot supply a substantial proportion of the crop need. Foliar nutrient application is useful when soil conditions restrict nutrient availability to roots. For foliar application of nutrients to be effective, a dilute solution of the nutrient must be able to supply the amount needed by the plant

A dilute nutrient solution, usually 5% or less dissolved nutrients on a weight basis, is necessary to minimize damage from leaf “burning” or desiccation from the solution. Dilute solutions supply small amounts of nutrients to foliage. For example, a 4% N solution weighing 8.5 lb/gallon is applied at 50 gal/a, supplies 17 pounds of N. If “extra” solution is added, liquid drips from the leaves to soil and if used by the plant, the nutrient will be assimilated through the roots. A solution containing 4% N is quite concentrated and will probably burn leaves and may scorch or kill leaves early in the season. Foliar applied nutrient solutions commonly contain less than 1% N.

Nutrient solutions have the ability to supply only a small amount of material with each application. Logically, they would be used to supply elements only required by plants in relatively small quantities, less than 10 lb/a, such as boron, manganese, iron, zinc, or copper, Table 1. In very few situations, foliar applications can significantly add to the amount of phosphorus, magnesium, and sulfur supplied to a crop.

The small quantities of zinc, iron, and boron used by plants made them likely candidates for foliar application in situations where nutrient supply through soil is limited, usually from high pH which limits iron and zinc solubility or “availability”.

Foliar application of boron in fruit and nut crops is an example of matching an amount of a material with foliar application to the amount needed by the crop and being able to deliver it to the needed plant part.

Foliar boron application to supply fruit buds with boron initially seems incorrect, as boron is not mobile in the plant and therefore should not logically move from the leaves to the fruit buds. First, consider that a small amount of boron is adsorbed by the flower bud. Second, when a sodium pentaborate solution is applied to leaves, the form of boron absorbed by the plant is mobile for about 48 hours. The short-term mobility allows boron movement to fruit buds. Foliar boron applications are made in the fall so fruit buds will have sufficient boron in the spring.

A parallel example is a late season (post-harvest) application of nitrogen for apples and pears. If nitrogen is withheld from a tree to reduce vigor or to develop color in fruit, leaf nitrogen concentration after harvest can be low enough that inadequate nitrogen is translocated from the leaves to the fruit buds, reducing flowering and potential fruit

[1] Reprinted from: Crop and Soil News/Notes. *March, 2004. Vol. 18, No. 2.* Oregon State University Extension Service http://cropandsoil.oregonstate.edu/newsnotes/

production the following year. In this situation, post harvest foliar application of 20 to 40 lb N/a will amply supply the fruit buds for spring growth.

Extrapolating the concept of “supplemental” foliar nitrogen or other nutrient application from fruit trees to perennial ryegrass is difficult unless a plant physiological requirement exists so that the timing of an application precedes a developmental stage. When fruit trees with adequate nitrogen concentration in the leaves received post harvest foliar nitrogen, no change in leaf or fruit bud nitrogen concentration or yield was measured. For a foliar nutrient application to be beneficial, the plant must need the nutrient, the nutrient has to be applied in a form that is mobile in the plant or can move to the point of use, and be applied before the plant needs/will use it. If all criteria are not met, foliar nutrient application will not be beneficial.

Let’s investigate the logic and success of routine foliar nutrient application to perennial ryegrass from the “boot’ to “early heading” development stages in late May to early June. The first step is to examine nutrient use or demand by perennial ryegrass. Figure 1 shows that peak aboveground accumulation of nitrogen and potassium occurs about mid-April, well in advance of the peak growth or biomass accumulation about three weeks later in early May. Anthesis typically occurs in mid-June, after nitrogen uptake is complete.

Perennial ryegrass naturally prepares for seed production by growing biomass or leaf photosynthesis “factory” with high nutrient content before seed production begins. As the seed fills, perennial ryegrass leaves send carbohydrates and nutrients to the seed. A 2000 lb/a seed yield contains about 45 lb N. The aboveground portion of the plant contains more than three times that amount, approximately 160 lb N/a. At seed fill, perennial ryegrass should contain sufficient nitrogen for seed development.

Proponents of late season foliar fertilization claim that May application provides nutrients that are readily transported to seed as they fill. To test this idea, foliar nutrients were applied to a perennial ryegrass seed stand at the Southern Oregon Research and Extension Center, near Medford.

The foliar fertilizer treatments were "Early" (materials applied at booting), "Late" (materials applied about three weeks later), "Early+Late", and "Control" (no foliar fertilizers applied). Each foliar fertilizer application included a tank mixture in water of Leffingwell NutraPhos Super K at 5 lb ac^{-1} and SorbaSpray ZNP at 2-quart ac^{-1}. NutraPhos Super K had an analysis of 713-34-0 + 12.5 Zn and was derived from Potassium Nitrate and Zinc Potassium Phosphate complex. SorbaSpray ZNP had analysis of 10-12-0-1 + 2.0% Zn, derived from urea, Ammonium Phosphate, phosphoric acid, and Zinc Sulfate.

These materials provided approximately 1 lb N, 1.25 lb P2O5, 1.75 lb K2O, and 0.75 lb Zn ac^{-1} per application. As a percentage of the total amount in the aboveground portion of a typical perennial ryegrass crop, the application supplied 0.7 % of the N, 4% of the P, 0.8 % K, and 500% of the Zn.

Table 1. Average amount of nutrients contained in 5.3 ton/acre of aboveground dry matter (seed and straw) of Pennfine and Linn Perennial ryegrass. Southern Oregon Research and Extension Center, Medford, OR.

Nutrient	Amount lb/a	Nutrient	Amount lb/a
Nitrogen	140	Magnesium	12
Phosphorus	14	Boron	0.08
Potassium	180	Copper	0.03
Sulfur	16	Manganese	3
Calcium	48	Zinc	0.15

Figure 1. Average daily aboveground accumulation of nitro-gen (a), potassium (b), and biomass (c) for Pennfine and Linn perennial ryegrass. Southern Oregon Research and Extension Center, Medford. OR

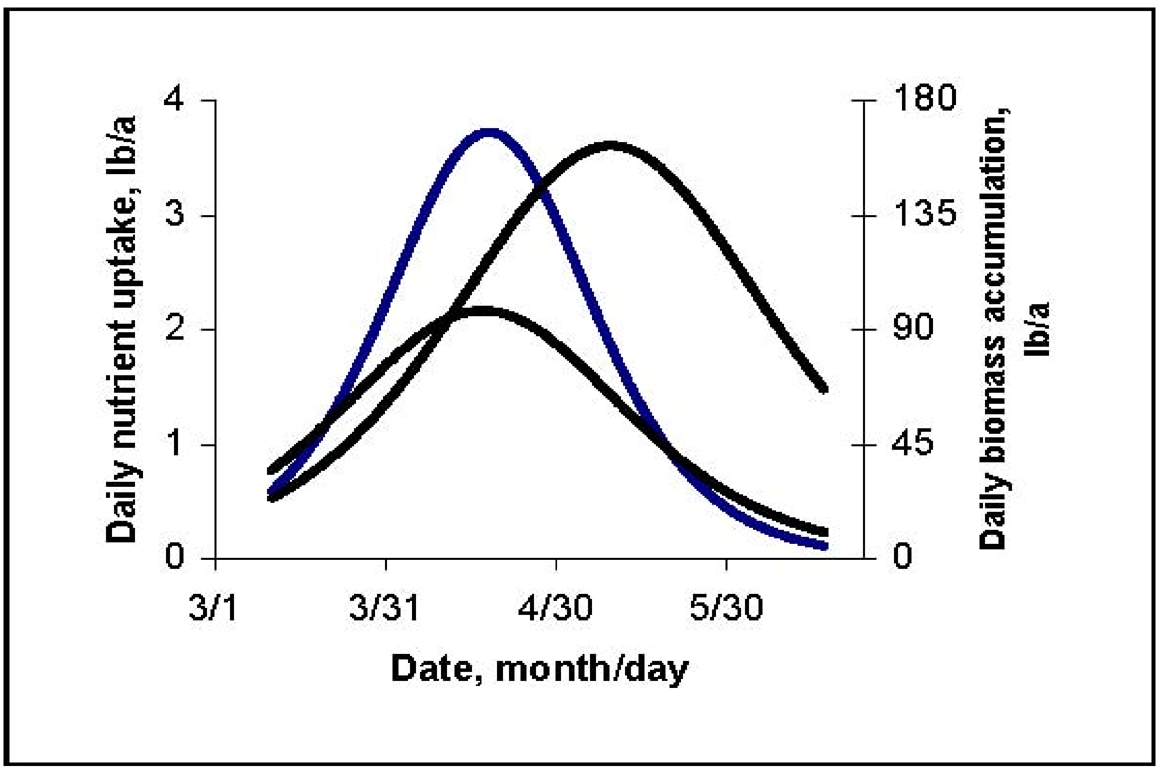

Table 2. Ryegrass seed yield & nutrient analysis at Southern Oregon Research and Extension Center, Medford, OR. 1990.

	Treatments[a]				
Variable	None	Early[b]	Late[c]	Early +	$LSD_{0.05}$ [d]
Seed Yield ($lb\ ac^{-1}$)	638	621	662	715	NS
Test Weight ($lb\ bu^{-1}$)	17.7	18.8	20.3	19.1	NS
Clean Out (% clean seed)	72.1	75.8	78	69.3	NS
<u>Seed Nutrient Concentration Values</u>					
N (%)	2.3	2.29	2.31	2.26	NS
P (%)	0.402	0.399	0.401	0.407	NS
K (%)	0.811a	0.734b	0.762ab	0.742b	0.064
Zn (ppm)	35.75	36.75	39.25	39	NS
Mn (ppm)	66.2	66	70.2	64.2	NS
<u>Seed Nutrient Uptake Values</u>					
N ($lb\ ac^{-1}$)	14.7	14.3	15.3	16.1	NS
P ($lb\ ac^{-1}$)	2.56	2.48	2.65	2.91	NS
K ($lb\ ac^{-1}$)	5.16ab	4.55b	5.03ab	5.30a	0.69
Zn ($oz\ ac^{-1}$)	0.365	0.366	0.417	0.446	NS
Mn ($oz\ ac^{-1}$)	0.67	0.66	0.74	0.73	NS

[a] Each application consisted of Leffingwell NutraPhos Super K @ 5 lb ac^{-1} and SorbaSpray ZNP @ 2 qt ac^{-1}, tank mixed in a solution applied @ 25 gal ac^{-1}.

[b] Early application when most seed heads were "in boot".

[c] Late application 3 weeks after early, a time when seed heads were visible on approximately 10% of the ryegrass plants.

[d] NS indicates no significant difference among all treatments and numbers followed by the same letter were not significantly different using the protected least significant difference test.