

Irrigated Kentucky bluegrass (Eastern Oregon) nutrient management guide

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Summary

Lime: If soil pH is below 5.5, apply lime and incorporate prior to planting.

Nitrogen (N): Rate varies by region. At least half of the total N for the season should be applied during October or November. N rate (pounds of N per acre per season):

- Grande Ronde Valley: 120–240
- Central Oregon: 140–260
- Columbia Basin: 175–325

Phosphorus (P): If soil test P is below 20 parts per million, apply P according to table 2.

Potassium (K): If soil test K is below 100 parts per million, apply at least 60 pounds of K_2O per acre according to Table 3.

Sulfur (S): If soil test S is below 10 parts per million and irrigation water is relatively free of S, apply 10 to 30 pounds of S per acre.

Kentucky bluegrass (*Poa pratensis* L.) is a widely used turfgrass in many temperate-climate areas of the United States and the world. It is an adaptable, long-lived perennial that forms a medium-textured, dark green turf with appealing leaf density and aggressive sod-forming rhizomes. Kentucky bluegrass is also included in pasture mixes. However, its low midseason forage yield, aggressiveness in mixtures and high nitrogen requirements limit its use as a forage grass.

In Oregon, Kentucky bluegrass seed is produced in three main irrigated crop areas: the Grande Ronde Valley near La Grande in Northeastern Oregon, the Madras and Culver areas in Central Oregon and the Lower Umatilla Basin near Hermiston in the southern portion of the Columbia Basin. Characteristics of these three areas are shown in Table 1.

Table 1. Characteristics of irrigated Kentucky bluegrass seed production areas in Oregon

Region	Elevation (feet above sea level)	Soil texture class	Soil organic matter (%)	Evapotranspiration (inches/season)
Grande Ronde Valley	2,600–3,200	Sandy loam and silt loam	2–4	14–18
Central Oregon	1,800–2,800	Loam and sandy loam	Below 2	14–19
Columbia Basin	200–1,500	Sand to loamy sand	0.5–2	18–25

Kentucky bluegrass seed production practices vary across these regions. In central Oregon and the Columbia Basin, Kentucky bluegrass is typically planted in late summer (August to September). In the Grande Ronde Valley, planting typically occurs in spring (late April to late May). Whether planted in spring or late summer, the first seed crop is harvested the calendar year following planting.

Following seed harvest, straw residue typically is baled and removed from the field. Postharvest baling removes approximately 2–4 tons of straw per acre. After baling, fields may be propane flamed.

Clean seed yield typically ranges from 800 to 1,600 pounds per acre, with yields being lowest in the establishment year, highest in production years 2 and 3, and then declining in subsequent years. Seed yield potential depends on variety and growing conditions.

With proper nutrient, water, residue, and pest management, a Kentucky bluegrass seed field can remain productive for four to six years, which is typical under central Oregon and Grande Ronde Valley conditions. The crop rotation is shorter in the Columbia Basin, and some growers there produce Kentucky bluegrass as an annual crop.

This guide provides nutrient and lime recommendations for irrigated Kentucky bluegrass in eastern Oregon during the establishment year and subsequent years of seed production. Among fertilizer nutrients, nitrogen (N) is the most yield-limiting nutrient for Kentucky bluegrass seed yield. Liming to increase soil pH may be necessary, as well as addition of phosphorus (P), potassium (K) and sulfur (S).

You can obtain maximum return from your fertilizer investment only if plants are healthy and have adequate roots. The nutrient recommendations in this guide are based on the assumption that adequate control of weeds, insects and diseases is achieved. Applying additional nutrients may not mitigate crop damage caused by uncontrolled pests.

Recommendations in this guide are based on research conducted on both large plots in grower fields and small plots at Oregon State University research facilities in Eastern Oregon.

Soil pH and lime

Kentucky bluegrass is well suited to a wide soil pH range, from 5.5 to 8.5. Therefore, application of lime is rarely needed for production. Except for molybdenum, micronutrient deficiencies are common in highly alkaline soils. As soil pH approaches 8.5, micronutrients such as iron, manganese, zinc, and boron become more strongly adsorbed to soil particles and less available to plants.

Soil pH decreases rapidly on irrigated sandy soil receiving urea or other ammonium-N fertilizers, even where lime is applied. In a wheat and potato rotation with an initial soil pH of 6.5, soil pH declined 0.15 unit/year. For more information about factors that influence soil pH, see OSU Extension publications PNW 599-E, [Acidifying soil for crop production: Inland Pacific Northwest](https://extension.oregonstate.edu/catalog/pub/pnw-599-acidifying-soil-crop-production-inland-pacific-northwest) (<https://extension.oregonstate.edu/catalog/pub/pnw-599-acidifying-soil-crop-production-inland-pacific-northwest>), and PNW 601-E, [Managing salt-affected soils for crop production](https://extension.oregonstate.edu/catalog/pub/pnw-601-managing-salt-affected-soils-crop-production) (<https://extension.oregonstate.edu/catalog/pub/pnw-601-managing-salt-affected-soils-crop-production>).

For optimum growth, apply lime when soil pH is less than 5.5. Measure soil pH at the same time each year, as pH changes 1 unit or more seasonally on sandy soil in eastern Oregon. Soil pH is lowest in summer and highest in winter or early spring before fertilizer is applied.

If lime is needed, mechanical incorporation before planting is much more effective than surface application to an established stand. Yield of an established stand rarely increases from a surface lime application.

Lime rate can be estimated using soil textural class or a laboratory test. When lime is needed on coarse, sandy soils, apply 1 ton per acre of 100-score lime. On loam and finer soils, apply 2 tons per acre of 100-score lime. A more accurate estimate is possible with the SMP buffer test (a rapid laboratory test performed by mixing a soil sample with a buffering solution). For more information about lime score and rates, see FG 52-E, [Fertilizer and lime materials](https://ir.library.oregonstate.edu/concern/administrative_report_or_publications/dv13zv00n?locale=en) (https://ir.library.oregonstate.edu/concern/administrative_report_or_publications/dv13zv00n?locale=en).

When soil test Mg is below 0.8 milliequivalents per 100 grams or 100 parts per million, dolomite can be substituted for lime.

Nitrogen (N)

Nitrogen fertilizer use varies by region and growing conditions (see table 1). Soil organic matter differs in the production areas. The amount of soil organic matter influences the amount of N fertilizer needed.

Total N application rates for a typical growing season are as follows:

- Grand Ronde Valley: 120–240 pounds of N per acre
- Central Oregon: 140–260 pounds of N per acre
- Columbia Basin: 175–325 pounds of N per acre

The lower end of each range is used for new stands and the higher end for established stands. Older stands generally have greater shoot density and therefore require more N fertilizer than young or new stands. At or before planting, 20–40 pounds of N per acre is necessary. Nitrogen can be broadcast before planting or banded with seed at planting.

Figure 1 shows N uptake and biomass accumulation from a Kentucky bluegrass field in Hermiston. Kentucky bluegrass in Central Oregon and the Grande Ronde Valley has similar growth and N uptake; however, the calendar dates are later because of cooler growing conditions.

Kentucky bluegrass begins to grow slowly at the end of winter and begins rapid N uptake two to three weeks later. Most of the N uptake for a seed crop is completed in a 60-day period. The peak rate of N uptake is approximately 4 pounds per acre per day, occurring about four to six weeks prior to swathing. By the time 50% of the above-ground dry matter has been produced, the crop has already taken up 90% percent of its N. Total N uptake varies with biomass (variety), but is expected to be between 120 and 160 pounds per acre.

Kentucky bluegrass growth is rapid and linear from the time it begins to grow in the spring until seed fill begins. During this period, the grass accumulates approximately 100 pounds of dry matter per acre per day. The growth rate slows as seed is set and maturation occurs. Total biomass production depends on variety, ranging from 3 to 5 tons per acre at harvest.

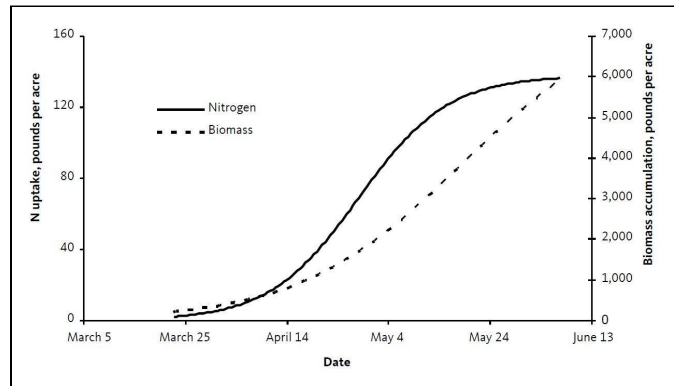


Figure 1. Average above-ground biomass accumulation and N uptake of Kentucky bluegrass grown at Hermiston, Oregon. Measurement is from spring growth. Above-ground biomass accumulation and N uptake occur later in the season in Central Oregon and the Grande Ronde Valley.

Credit: © Oregon State University

Nitrogen must be available before rapid plant uptake in the spring. Data from the Columbia Basin suggest that N can be applied just before Kentucky bluegrass breaks winter dormancy. However, in winter and spring, conditions may not enable timely application of N to ensure adequate incorporation (via precipitation or irrigation) and soil availability prior to rapid plant uptake. The window of application opportunity in the spring may be only one to two weeks.

Seed yield reductions can occur if all required N is applied in the spring, so we recommend splitting N applications between fall/spring. Apply one-half or more of the total N for the season during October or November (Figure 2).



Figure 2. Apply half of the total seasonal N during October or November.

Credit: Darrin L. Walenta, © Oregon State University

Nitrogen volatilization

Urea, ammonium sulfate (also called AMS) and urea-ammonium nitrate (also called UAN or solution 32) fertilizer products are susceptible to N loss through ammonia volatilization.

Volatilization is the movement of ammonia from the soil surface into the atmosphere as gas. As ammonium-N is lost to the atmosphere, the efficiency of N fertilizer application is reduced. Excessive N loss from Kentucky bluegrass fields can result in low seed yield and unsustainable production.

Volatilization loss occurs while fertilizers lay on the soil surface. Factors that increase the risk of ammonia volatilization are:

- Fertilizer with ammonium or urea-nitrogen
- Length of surface exposure time
- Moisture, such as dew, that softens fertilizer pellets but does not completely dissolve them
- High wind speed
- Presence of surface residue from previous crop(s)
- High soil pH

Urea is the most common form of N fertilizer used in irrigated Kentucky bluegrass production, and it is especially susceptible to volatilization. When urea is applied to moist soil with plant residue, conversion to ammonia (NH_3) begins immediately. This process causes a sharp increase in soil pH close to the urea granule, leading to increased ammonia volatilization.

Volatilization is dependent on urease, an enzyme produced by soil microorganisms. The amount of urease present increases with increasing plant residue on the soil surface.

At most, 50% of the N in surface-applied urea fertilizers can be lost to volatilization. Recent research indicates that a 20–30% loss is typical in bluegrass fields. Ammonia volatilization from surface-applied urea fertilizers can be minimized by:

- Treating these fertilizers with a urease inhibitor (such as Agrotain) prior to application
- Irrigation with one-half inch of water or more within 24 hours of application

For more information, see Montana State University Extension publication EB 173, [Management of urea fertilizer to minimize volatilization](https://www.researchgate.net/publication/237772283_Management_of_Urea_Fertilizer_to_Minimize_Volatilization) (https://www.researchgate.net/publication/237772283_Management_of_Urea_Fertilizer_to_Minimize_Volatilization).



Figure 3. Burning increases soil pH at the surface, thus increasing the likelihood of N volatilization from fertilizer on the soil surface.

Credit: Rich Affeldt, © Oregon State University

Phosphorus (P)

Soil test levels below 20 parts per million P indicate the need for P fertilization (Table 2). When P fertilizer is necessary for a new seeding, broadcast and incorporate it prior to planting.

On established stands, P fertilizer can be surface applied in the fall, but stratification of P in the soil may occur. Topdress P applications for more than three years may require separate 0- to 2-inch and 3- to 12-inch soil samples to adequately characterize soil P (see the “Stratification”).

Phosphorus concentration in straw is lower than K concentration. Thus, without P fertilizer application, P soil test values do not decrease as rapidly as K soil test values when straw is removed from fields. Field burning returns P to the soil.

Potassium (K)

When soil test K is below 100 parts per million, apply at least 60 pounds K_2O per acre. When K fertilizer is necessary for a new seeding, incorporate it before planting. For established stands, topdress K fertilizer in the fall or late winter. Soil test K above 100 parts per million will not limit seed yield.

For a new seeding, 0- to 12-inch soil samples are appropriate, assuming uniform vertical distribution of K following primary tillage or other ground preparation that thoroughly mixes soil. Topdress K applications for more than three years may require separate 0- to 2-inch and 3- to 12-inch soil samples to adequately characterize soil K (see “Stratification”). Grande Ronde Valley grass seed fields are more likely to develop K stratification because of longer stand life.

Postharvest residue management influences the rate of soil K depletion. Field burning returns K to the soil, while baling removes a substantial amount of K (see “Nutrient removal”). A straw bale survey indicated that straw contains 35 to 55 pounds K per ton. Assuming two to three tons of straw per acre is removed, 70–165 pounds K per acre is removed annually. Where the straw load was not removed, soils contained approximately 100 parts per million more K in a 0- to 2-inch soil sample than where the residue was removed by vacuum sweep. Monitoring soil K at least once per rotation will determine K fertilization need.

Table 2. Fertilizer phosphorus rate recommendations for preplant or fall broadcast applications on Kentucky - bluegrass

Soil test P* (ppm)	Apply this amount of P_2O_5 (lb/a)
0–5	50–60
5–10	40–50
10–20	30–40
Over 20	0

*Soil test P determined by bicarbonate extraction (Olsen).

Table 3. Fertilizer potassium rate recommendations for preplant or fall broadcast applications on Kentucky bluegrass

Soil test K* (ppm)	Apply this amount of K_2O (lb/a)
Below 100	60
Over 100	0

*Soil test K determined by ammonium acetate extraction.

Sulfur (S)

Soil tests for S are difficult to interpret because sulfate (SO₄--S) is mobile in the soil and irrigation water may contain enough S to satisfy crop need. In general, however, no additional S is needed when soil test SO₄--S is above 10 parts per million in the surface 12 inches of soil (calcium chloride extraction method).

Where S is needed, annual fertilization with 10–30 pounds S per acre provides adequate S for grass growth and seed production. The higher end of this range is appropriate where soils are less than a foot deep or are very sandy and irrigation water does not contain much S. However, irrigation water commonly contains some S, as do some N fertilizers. Irrigation water analysis will give information needed to make S application decisions.

Combined straw and seed biomass contains approximately 15–20 pounds S per acre annually. Burning residue results in loss of S to the atmosphere.

Micronutrients

Apply boron (B) when soil test B is less than 0.3 parts per million (hot water extraction method). Boron should be surface broadcast at a rate not exceeding 1.5 pounds B per acre.

Zinc (Zn) deficiencies are rare. Consider an application of Zn when soil test levels are below 0.6 parts per million in the surface 12 inches of soil. Zinc fertilizer should be surface broadcast at 5 pounds Zn per acre.

Fertilization of Kentucky bluegrass with copper (Cu), iron (Fe), manganese (Mn), or molybdenum (Mo) has not been demonstrated to be necessary in Eastern Oregon.

Stratification

Stratification, or large differences in soil test values with depth, occurs when surface-applied fertilizer is not mechanically incorporated. For example, surface application of potassium, phosphorus, and lime changes soil test values only in the top 1 or 2 inches. Irrigation or rainfall does not disperse these materials; mechanical mixing is required. In a 3-year-old stand, a 0- to 12-inch soil sample may not characterize nutrient availability. Therefore, where stratification is likely, collect separate 0- to 2-inch and 3- to 12-inch soil samples.

Stratification is a function of fertilizer application rate and tillage. Once a field is tilled, stratification is eliminated.

Foliar nutrient application

Foliar nutrient applications should be considered only when all of the following conditions are met:

- Nutrient deficiency is visible in a growing crop.
- Deficiency is verified by leaf analysis.
- Nutrients can be absorbed through leaves in sufficient quantities to alleviate the deficiency.

A combination of such factors is extremely rare for grass seed production.

Only small quantities of nutrients can be delivered safely at one time through a foliar application. Micronutrients are well suited for this type of application. However, foliar-applied micronutrients have not been shown to increase seed yield.

Nutrient removal

Nutrients are exported from the field in harvested seed and baled straw, and this removal of nutrients may result in soil nutrient decline. The average amounts of nutrients removed in seed and straw are summarized in tables 4 and 5.

Baling removes significant amounts of K. One-half inch of rainfall or irrigation prior to straw removal can leach approximately 50% of the K from residue, retaining K in the field.

Straw nutrient analysis, in combination with straw yield, will help you estimate nutrient removal from your field. Contact an agricultural service laboratory for straw nutrient analysis.

Table 4. Average nutrient concentration in Kentucky - bluegrass seed and baled straw (Eastern Oregon)

Nutrient	Nutrient in seed (%)	Nutrient in straw (%)	
		Range	Average
Nitrogen (N)	2.7	0.9–2.0	1.3
Phosphorus (P)	0.4	0.1–0.3	0.2
Potassium (K)	0.5	1.8–2.7	2.4

Table 5. Average nutrient removal from harvested Kentucky bluegrass seed and baled straw (Eastern Oregon).

Nutrient	Nutrient removed in seed (lb nutrient/1,000 lb seed)	Nutrient removed in baled straw (lb nutrient/lb straw)
Nitrogen (N)	27	30
Phosphorus (P)	4	5
P₂O₅	9	11
Potassium (K)	5	43
K₂O	6	52
Calcium (Ca)	3	7
Magnesium (Mg)	2	3
Sulfur (S)	2	4
Zinc (Zn)	*	*
Manganese (Mn)	*	*
Copper (Cu)	*	*
Boron (B)	*	*

*Usual or typical micronutrient content is minimal — from 0.01 to 0.05 pound per 1,000 pounds of seed or ton of straw.

For more information

[Acidifying soil for crop production: Inland Pacific Northwest](https://extension.oregonstate.edu/catalog/pub/pnw-599-acidifying-soil-crop-production-inland-pacific-northwest) (<https://extension.oregonstate.edu/catalog/pub/pnw-599-acidifying-soil-crop-production-inland-pacific-northwest>), PNW 599-E (Oregon State University).

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[Northern Idaho fertilizer guide: Bluegrass seed](https://www.uidaho.edu/-/media/uidaho-responsive/files/extension/publications/cis/cis0788.pdf) (<https://www.uidaho.edu/-/media/uidaho-responsive/files/extension/publications/cis/cis0788.pdf>), CIS 788 (University of Idaho).

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