Residents of Quelah *get a spectacular view of Mt. Bachelor and the surrounding Sunriver resort area.*

Native poppies *provide color in Marvin Mix's landscape plan for Quelah.*

start refining things."

Alberello

Don't mention the word "bark" to Mike Dawkins.

The landscape maintenance manager at the brand new Alberello condos will grimace.

"You mention low maintenance and native landscaping and most contractors (around here) think of junipers and bark."

Not Mike Dawkins.

He is a firm believer that native doesn't have to be synonymous with stark. Native flowers and shrubs are an integral part of his landscape designs. Using drip irrigation is also high on the list of priorities.

Dawkins, 38, is one of three partners in Cascade Garden Center. The company has 30 clients, mainly residential. Most are landscape design clients, not maintenance. In fact, the barely year-old Alberello is his only townhouse/condo maintenance contract. Only 10 of its 26 units are completed. The rest are currently being built. Alberello has two permanent residents. Most units are vacation homes; the others vacation rentals. Units start at $145,000.

Each unit has its own courtyard which is completely irrigated.

Dawkins can't say enough about drip irrigation. He uses Microjets which are most widely used in citrus grove irrigation.

"The way the water is put out, it's just like a slow, soaking rain," explains Dawkins, "and it usually costs about 1/4 of what traditional systems cost to run. That leaves me more money for plants."

Dawkins also likes the ease of installing drip systems.

"I think cost and ignorance are the main reasons why more people don't use it (drip)."

Dawkins used Fortress fine fescue in the area between the residences and the golf course onto which Alberello abutts.

"It's a low maintenance grass that blends well into the rough of the golf course," he says.

Chipmunks are a major problem at Alberello and Quelah. Situated in the Deschutes National Forest, the area is full of them. They find Dawkins' succulent plants a particular treat.

"They're a real problem and we have to design what we plant around the critters."

Like Mix, lack of a growing season is also a problem for Dawkins.

He uses a lot of native kinnkinnick groundcover to "cement" the earth. Potentilla, another native flowering deciduous shrub, is used extensively. Beds of daffodils and rambling roses are also used for color.

An alpine garden is in the works for a slope on one side of the tennis courts. Three hundred plants from as far away as South Africa, Asia and the Himalayas, will provide a stunning focal point on the slope facing the entrance to the complex.

"The different types of plants will provide different color breaks and will extend the blooming season. The alpine plants will also keep with the natural setting of the woods and rocks."

Penstemmons, saponaria, phlox, campanula, sedum and saxifraga will be part of the garden.

Dawkins, a bird lover, said he plants a lot of berry-bearing bushes such as choke cherries, beech plum, vibernum and manzanita.

Dawkins has been a full-time landscaper since age 17. He grew up on a golf course surrounded by a housing development his father owned. He did the landscaping there and his career as a professional landscaper was launched.

He majored in biology with an emphasis in botany at Southern Oregon State. He's lived in the Sunriver area seven years.

He did the landscaping there and his career as a professional landscaper was launched.

Dawkins and his partners are optimistic about the area's growth. Business has been so good, Cascade Gardens usually will not maintain a development it didn't design. **WT&T**

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For best results always read and follow the label directions.

Precautions: Applications of Rubigan to turfgrass areas containing *Poa annua* (annual bluegrass) may result in the gradual reduction of this species from the turfgrass area. Cumulative dosages of 5 pounds of Rubigan 50W per acre or 2 ounces per 1,000 sq. ft. are usually necessary for this response to occur. If such a reduction or loss of *Poa annua* is not acceptable to the user, Rubigan can be used at the minimal label rate (0.2 oz. 50W/1,000 sq. ft.) or in alternating application with contact type fungicides.

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1984 Guide to Turf, Tree and Ornamental Fertilization

by **Richard Rathjens, Ph.D., and Roger Funk, Ph.D.**, Davey Tree and Lawnscape companies, Kent, OH

Plants require at least 16 elements for proper growth and development. Three of the elements—carbon, hydrogen and oxygen—are provided by air and water; the other essential elements are obtained from the soil.

The **macronutrients**, nitrogen, phosphorus and potassium, are often called the primary nutrients because of the amount used by the plants and their importance in supplemental fertilizers. Magnesium is also considered a macronutrient.

The **micronutrients**, iron, manganese, copper, zinc, boron, molybdenum and chlorine, are required in smaller quantities but are no less important. Because of reserves normally found in soil, the addition of supplemental micronutrients is not often necessary unless the soil is excessively alkaline or sandy.

FERTILIZERS

Fertilizer is any material that supplements the soil's supply of elements required for plant growth and development. Fertilizers may be categorized as natural organic, synthetic organic or inorganic based on their source and chemical structure.

Organic fertilizer consists of nutrient elements derived from compounds with a carbon structure. All living matter—plant or animal—is composed of compounds with a carbon structure. Compounds synthesized by organisms have one common factor—a carbon structure. Any of these materials could be considered as organic fertilizers

Common examples of **natural organic** fertilizers are animal manure, bonemeal, sewage sludge and plant refuse. Scientists have synthesized compounds with a carbon structure which are also organic. Examples of **synthetic organic** fertilizers are ureaformaldehyde and isobutylidene diurea.

Urea is technically an organic fertilizer since it contains one carbon. It is both naturally (bird manure) or synthetically produced. Although technically organic, it has the quick-release properties of inorganic fertilizers and should not be considered an organic fertilizer.

Inorganic fertilizers are nutrient elements derived from sources which are not organic; that is, from sources which neither have a carbon structure nor have been derived from living matter. Examples of inorganic fertilizers are ammonium nitrate, ammonium phosphate, potassium nitrate and potassium chloride.

Fertilizers may contain both organic and inorganic components. Generally, organic compounds are insoluble in water while inorganic compounds are water soluble. Therefore organic compounds release elements more slowly. An exception, urea, is an organic material that releases nitrogen fairly rapidly.

A **complete** fertilizer contains sources of nitrogen, phosphorus and potassium. An **incomplete** fertilizer contains one or two of these elements in any combination, but never all three. Other fertilizer nutrients such as iron or magnesium may be present but are not considered in the definition of "complete" and "incomplete" fertilizers.

Analysis and ratio

Fertilizer analysis or grade is the minimum guaranteed **percentage by weight** of nitrogen (N), phosphorus (expressed as P_2O_5 equivalent), and potassium (expressed as K_2O equivalent), and is printed on the container in that order.

For example, a 100-pound bag of 20-10-5 fertilizer is formulated from nitrogen source(s) that supply 20 pounds of elemental nitrogen, phosphorus source(s) that supply the equivalent of 10 pounds of P_2O_5, and potassium source(s) that supply the equivalent of 5 pounds of K_2O.

Any of these elements missing from the formulation would be represented by a zero in the analysis. Ammonium nitrate, for example, which does not contain phosphorus or potassium, has an analysis of 33-0-0.

In addition to the total nitrogen, water insoluble nitrogen (WIN), if present, is also printed on the label as a percent of the total weight. For

Salt Indexes of Common Fertilizer Sources*

	Fertilizer	Formula	% N	% P_2O_5	% K_2O	Salt Index	Partial** Salt Index
Nitrogen	Ammonium nitrate	NH_4NO_3	35.0	—	—	104.7	2.99
	Ammonium sulfate	$(NH_4)_2SO_4$	21.2	—	—	69.0	3.25
	Sodium nitrate	$NaNO_3$	16.5	—	—	100.0	6.06
	Potassium nitrate	KNO_3	13.8	—	—	73.6	5.34
	Urea	H_2NCONH_2	46.6	—	—	75.4	1.62
	Natural organic		4.0	—	—	3.5	0.70
	Monoammonium phosphate	$NH_4H_2PO_4$	12.2	—	—	29.9	2.45
	Diammonium phosphate	$(NH_4)_2HPO_4$	21.2	—	—	34.2	1.61
Phosphorus	Superphosphate	$Ca(H_2PO)_2 + CaSO_4$	—	20.2	—	7.8	0.39
	Triple superphosphate	$Ca(H_2PO_4)_2$	—	48.0	—	10.0	0.21
	Monoammonium phosphate	$NH_4H_2PO_4$	—	61.7	—	29.9	0.49
	Diammonium phosphate	$(NH_4)_2HPO_4$	—	53.8	—	34.2	0.64
	Monopotassium phosphate	KH_2PO_4	—	52.2	—	8.4	0.16
Potassium	Potassium chloride	KC1	—	—	60.0	116.3	1.94
	Potassium nitrate	NO_3	—	—	46.6	73.6	1.58
	Potassium sulfate	K_2SO_4	—	—	54.0	46.1	0.85
	Monopotassium phosphate	KH_2PO_4	—	—	34.6	8.4	0.24

* Adapted from: Rader, Jr., L.F., L.M. White and C.W. Whittaker. 1943. The Salt Index—A Measure of the Effect of Fertilizers on the Concentration of the Soil Solution. Soil Science Volume 55, pp 201-218.

** Calculated per unit of N, P_2O_5, OF K_2O.

example, if half of the nitrogen of a 20-10-5 fertilizer is in a water-insoluble form, the WIN content is 10%.

Although WIN indicates the portion of nitrogen in a controlled-release fertilizer that is slowly soluble, it is not appropriate for coated fertilizers that encapsulate soluble nitrogen, such as sulfur coated urea. Instead, results of a coated slow release nitrogen (CSRN) test are listed on the bag. For a more detailed discussion, see Slow-Release Nitrogen.

Fertilizer ratio is the relative amounts of nitrogen, phosphorus and potassium. A fertilizer with an analysis of 20-10-5 would contain four times as much nitrogen as potassium and twice as much phosphorus as potassium. The ratio then would be 4:2:1.

Absorption

All fertilizer nutrients, regardless of the source, are absorbed by plant roots as charged atoms or groups of atoms called ions—the nutrient salts. These ions exhibit either a positive or a negative charge which is essential for root absorption by electrical attraction.

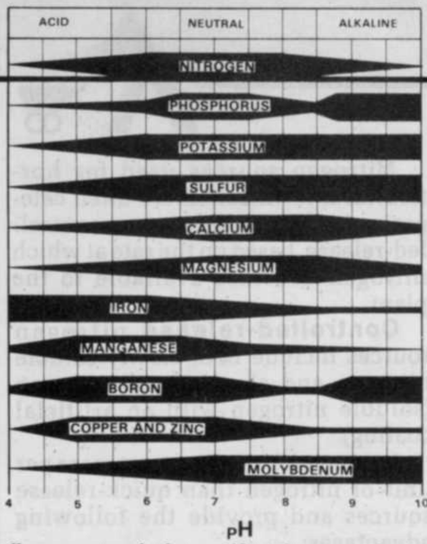
Inorganic fertilizers form ions readily when dissolved in water and therefore are quickly available for root absorption. Organic fertilizers—both natural and synthetic—must be hydrolyzed or decomposed by soil microorganisms from complex compounds to the same nutrient salts provided by inorganic fertilizers. The rate of decomposition is dependent upon many soil factors such as temperature, moisture and pH.

Burn

Fertilizer burn is the visible symptom of insufficient water in a plant associated with an overapplication of fertilizer salts.

The movement of water through the root cell membrane is regulated by the concentration of dissolved fertilizer salts in soil solution outside the cell relative to the concentration of dissolved salts within the cell. The cell membrane tries to control the concentration of salts on both side of it by allowing water (and dissolved salts) to flow from one side of the membrane to the other.

Normally, the plant cell takes in both water and salts. If too much fertilizer is applied to the soil and is dissolved by soil water, the high concentration of salts outside the plant cell will cause the membrane to stop the inflow of water or to let water



flow out of the cell. The result is known as fertilizer burn or physiological drought.

Salt index values are a measure of a fertilizer's relative tendency to increase the concentration of salts in the soil solution. Sodium nitrate has been given a salt index value of 100 and the value for all other fertilizers is relative to an equal weight of sodium nitrate. The higher the salt index, the greater the potential for a fertilizer to cause burn.

Because some nutrient sources are more concentrated than others (that is, have a higher percentage of N, P_2O_5 or K_2O) the actual increase in burn potential is affected by the application rate as well as the salt index. The partial salt index is calculated per unit of each nutrient and compares the relative burn potential of fertilizers based on equal amounts of nitrogen or P_2O_5 or K_2O equivalents.

Soil pH

The term pH expresses the relative concentration of hydrogen (H¢) and hydroxyl (0H-) ions in solution. A pH of 7.0 means the hydrogen and hydroxyl ions are equal and the solution is said to be **neutral**. A pH below 7.0 indicates the soil solution contains more hydrogen ions than hydroxyl ions and is said to be **acid**. Similarly, a pH above 7.0 means the solution is **alkaline**, containing more hydroxyl than hydrogen ions.

The soil pH may influence nutrient absorption and plant growth through the effect of hydrogen ions and their indirect influence on nutrient availability. In most soils the latter effect is the most significant.

The presence of an element in the soil is no guarantee that it is in a soluble form available for absorption. The concentration of hydrogen and associated ions affects soil reaction and the formation of soluble and insoluble compounds. All nutrients must be soluble to be available for root absorption. Each nutrient has a pH of maximum availability simply because within this range it forms a large proportion of soluble compounds. The relationship between soil reaction and nutrient availability for 12 of the essential elements is shown in a table in this article.

Plant species differ in their response to soil acidity because of differences in nutrient requirements. For most plants the conditions of nutrient availability, without toxic amounts, are **best near pH 6.5**. However, certain plants—such as rhododendrons, azaleas, pines and camellias—require comparatively large amounts of nutrients that are soluble in acid solution. They are "acid-loving" plants and grow best in soils of about pH 5.5.

Soil acidity, as such, is seldom toxic to plants but in soils with pH values below 5.5, certain elements such as aluminum or manganese may become soluble to levels toxic to plant growth.

In some cases, nutrient availability can be improved by correction of the soil pH as well as by supplemental fertilization. Sulfur and agricultural lime are the materials used most frequently to alter the soil reaction or pH. **Lime increases the pH** (decreases acidity); **sulfur lowers the pH** (increases acidity).

Ideally, the pH of soil within the root zone of a plant should be measured every three to five years and, if necessary, adjusted to the most favorable range for that particular species. Unfortunately, lowering the pH of an alkaline soil is not always successful, particularly if the soil is inherently calcareous with significant calcium reserves.

Leaching

Leaching is the removal of materials in solution from the root zone. Leaching is caused by percolation, the lateral and downward movement of water through soil.

Loss of nutrients due to leaching is proportional to the amounts of water percolated through the soil. Water dissolves minute quantities of mineral and organic matter which commonly move with the water. Since soil and weather conditions vary throughout the United States, leaching affects soils of humid regions more, on the whole, than it does most soils of dry regions.

All nutrients are subject to leaching, although not to the same degree. Calcium losses are the greatest of any nutrient known. Nitrate salts—the

form of nitrogen primarily absorbed by plant roots—moves with ground water and rapidly leaches from the root zone. Magnesium, sulfur and potassium are moderately leached, whereas only a trace of phosphorus is lost.

PRIMARY NUTRIENTS

Nitrogen, phosphorus and potassium are the three macronutrients required in the greatest quantity from the soil and are commonly applied for turfgrass and landscape plants. In addition to the primary fertilizer elements, the micronutrient iron is most likely to be found deficient in soils. Other elements which are sometimes deficient may be determined by soil and tissue analysis or by testing plant response.

Nitrogen

Nitrogen is required in larger amounts than other elements supplied by the soil and is formed into compounds that comprise up to 50% of the dry weight of plant cells. It is more often deficient in soils than any of the other essential nutrients.

Plants can absorb nitrogen as either the ammonium (NH_4+) or nitrate (NO_3-) ions. Urea or inorganic forms of nitrogen are converted to ammonium which is subject to volatilization when surface applied. Where conditions favor volatilization, 25% or more of the applied nitrogen may be lost in the atmosphere.

Because of the transitory nature of nitrogen in mineral soils, soil analysis is not as useful in determining deficiencies as an observation of symptoms. Nitrogen deficiencies are observed as uniformly yellowish-green leaves or needles which are more pronounced in older tissue. Leaves are small, thin and may start dying at the tips.

Nitrogen sources used for horticultural fertilization are often categorized as quick-release or controlled-release, based on the rate at which nitrogen becomes available to the plant.

Controlled-release nitrogen sources include both slowly soluble nitrogen and slow release nitrogen (soluble nitrogen with an artificial coating).

In general, both types cost more per unit of nitrogen than quick-release sources and provide the following advantages:

1 supply nitrogen gradually which reduces the number of applications necessary
2 reduce nitrogen leaching and volatilization which increases efficiency
3 reduce risk of burn which allows higher application rates.

Slowly soluble nitrogen includes natural and synthetic organic fertilizers which are slowly soluble (not urea) and are broken down by hydrolysis and/or microbial activity into soluble forms of nitrogen .

Natural organics include sewage sludge and plant and animal wastes, generally low in nutrient content. Milorganite (6% N) is a granular sewage sludge produced by the City of Milwaukee, WI, since 1926. Milorganite has been the most widely used natural organic for turfgrass fertilization.

Low analysis natural organic fertilizers are less prone to damage turf or plants through incorrect equipment calibration than other fertilizers.

The most common synthetic organic nitrogen sources are ureaformaldehyde (UF) and isobutylidene diurea (IBDU).

Ureaformaldehyde Reaction Products are synthesized by reacting urea

with aldehyde. Formaldehyde is the most common aldehyde used.

UF reaction products range from those which are predominantly soluble, short-chained methylol urea, to those which contain short- (soluble) and long- (insoluble) chained methylene ureas.

All longer-chained methylene ureas depend on **microbial decomposition** for release of nitrogen. Factors such as **soil temperature**, which affects microorganism activity, may then also affect the rate at which nitrogen is released from these products. UF reaction products which contain water insoluble nitrogen are particularly sensitive to changes in microorganism activity.

Since 1977, several liquid forms of UF reaction products have become available for liquid fertilization. Hawkeye's Formolene (30% N) and Georgia Pacific's 4341 (30% N) are two fertilizers which contain soluble methylol urea as the predominant UF compound. In addition, both products contain approximately 50% free urea.

C.P. Chemical's Nitro-26 (26% N) is a solution of methylene urea and approximately 15% urea. Cleary's Fluf (18% N) is a suspension liquid (a liquid containing microfine particles) which, like Nitro-26, contains methylene urea as its predominant UF compound and approximately 15% urea. In addition to soluble, short-chained methylene urea, Fluf contains 20% water insoluble, long-chained methylene urea.

With liquid UF reaction products, knowledge of the relative amounts of urea, methylol urea, methylene urea, and water insoluble nitrogen can be used as a guide in predicting their potential to cause fertilizer burn.

Products which contain water insoluble nitrogen and/or are predominantly methylene urea would have a lower potential to burn than those containing methylol urea. Liquids which have a lower urea content would also have a lower potential to burn.

For these reasons, Fluf would have the least potential for burn, followed by Nitro-26 and then Formolene and GP4341. Although field tests have verified the burn potential of these products in the order given, the magnitude of the difference between the products is not great.

Tests have shown that all UF reaction products have a substantially lower potential to burn than urea. Research has also demonstrated little difference between these products and urea regarding the rate at which nitrogen releases.

Another UF reaction product which is available in both a powder and a granular form is O.M. Scott and Sons' methylene urea fertilizers. Scotts first introduced methylene ureas into their fertilizer products in 1958.

Scotts' fertilizers include both water soluble and water insoluble methylene ureas. The water soluble portion ranges from approximately 40% for nursery stock to 70% for turfgrass fertilization. Although Scotts produces both complete and incomplete fertilizers containing methylene ureas, the fertilizers containing nitrogen only range from 38% to 41% nitrogen. Length of nitrogen release is up to 2 months for turfgrasses and from 2-6 months for container grown nursery plants.

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