# MANAGE SALT, MANAGE STRESS

An understanding of the potential salt effect of the various fertilizer materials can help the turf manager prevent fertilizer burn.

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A crucial element of fertilizer selection is knowing that plant availability of essential elements is influenced by a fertilizer's salt index.

Fertilizer burn, certainly, is the extreme end result of adverse osmotic pressure in the soil solution. But high salt index fertilizers cause other plant problems that do not show up as dramatically as turf burn. Factors other than salt index should be understood by those serious about managing turfgrass against damage and stress.

A turf manager usually chooses a fertilizer based on such factors as cost, availability and—perhaps—its physical characteristics. But another characteristic associated with each of the nutrient-containing chemicals should be considered before selecting a fertilizer. This characteristic concerns the method through which nutrients become available to the plant.

Nutrients enter the plant through its roots as it draws water from the soil (from what is technically called the soil solution). So nutrients must first become part of the soil solution, regardless of whether they were applied as a liquid or a solid. That is, the nutrients must sooner or later become a part of the soil solution in order for them to be used by the plant. But even once the nutrients are part of the soil solution, they won't necessarily move into the plant through its roots. The determining factor is osmotic pressure.

## Osmotic pressure

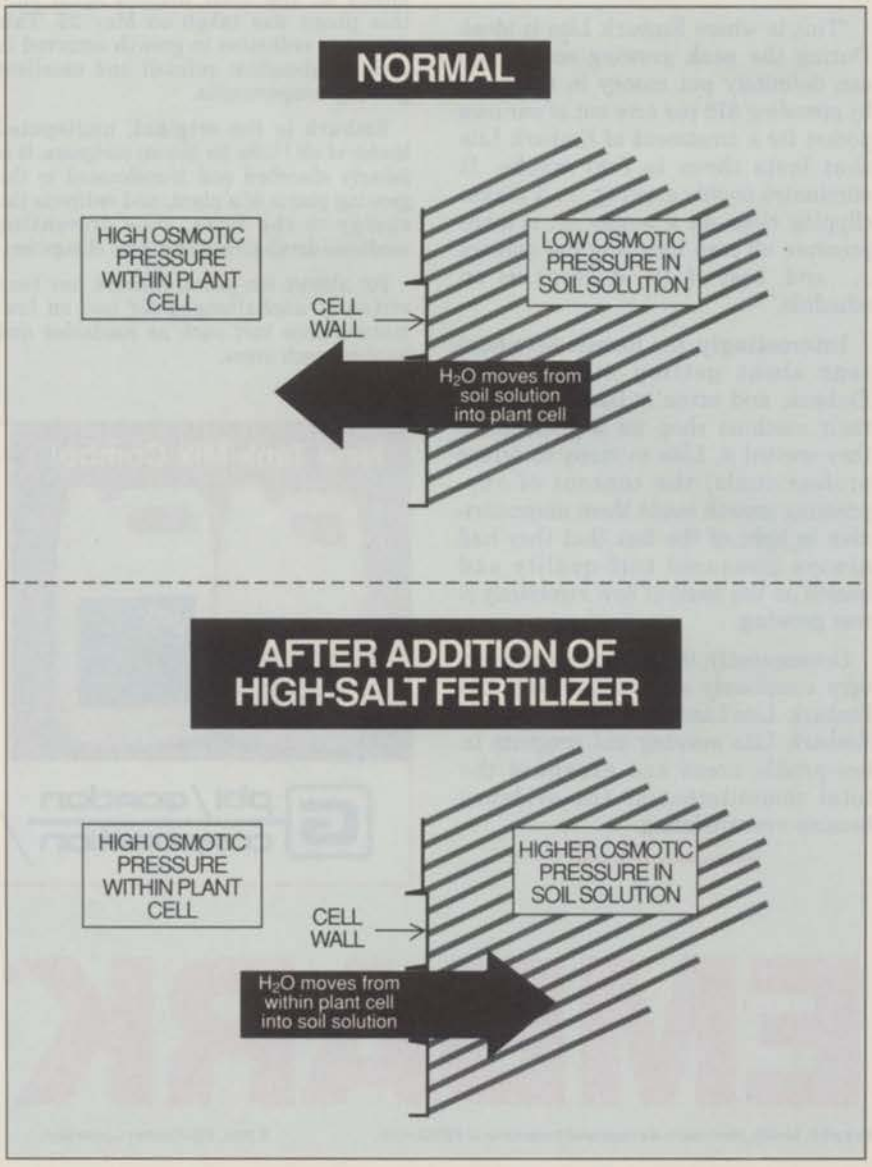
What is osmotic pressure and what does it have to do with the movement of nutrients? Osmotic pressure, in a sense, is a measure of how tightly molecules of water are held together in a solution, the very solution in which turf nutrients have dissolved.

The nutrient-containing chemicals in fertilizers are salts. As salts, they can change the osmotic pressure of a solution, and therein lies at least a potential concern. In order for roots to take up water, it must pass through a cell membrane. This process is only possible when the osmotic pressure of the cell sap is higher than the osmotic pressure of the soil solution outside the cell (Figure 1).

## Influences on pressure

Water moves out of a solution that has a *low* osmotic pressure (like the soil solution) and into a solution that has a higher pressure (like plant root cells).

For water to move into plant root cells, the osmotic pressure within the roots must be higher than the osmotic pressure of the soil solution. On the



other hand, if a fertilizer causes an increase in the osmotic pressure of the soil solution above that of the cell sap, water is withheld and may actually be withdrawn from the plant. The result is called "fertilizer burn."

Virtually every fertilizing chemical—organic or inorganic—can cause some increase in the soil solution's osmotic pressure, with effects ranging from minimal to serious. Of course, the rate at which any material is applied has a profound effect on the osmotic pressure. The term "salt index" has been devised to help evaluate a given material's potential to change osmotic pressure.

*Watering in a fertilizer helps move soil moisture and dissolved nutrients into root cells.*

The salt index of sodium nitrate is given the value of 100 (see Tables 1 and 2) and all other materials are compared to the effect of an equal amount of sodium nitrate. The higher the salt index, the greater that material's potential to increase the soil solution's osmotic pressure and thus burn potential. As indicated in Tables 1 and 2, there are wide difference in the salt indices for commonly-used turf fertilizers.

Note that Table 1 also lists the salt indices of selected nitrogen fertilizers in terms of single units of nitrogen (based on application on a unit basis, lbs./1000 sq.ft.). Although a material such as ammonium sulfate (21 percent nitrogen) has a lower salt index than urea, the salt effect of applied urea is lower because it contains a higher percentage of nitrogen (45 percent).

Consideration should also be given when selecting a potassium source. Note that the salt index of potassium suilfate (0.9) is less than half that of potassium chloride (1.9). Additionally, potassium sulfate is a source of sulfur, a nutrient that turfgrass generally requires at levels similar to those of phosphorus.

### Other factors

Burn potential is not totally dependent on the fertilizer's salt index. Moisture status of the soil and the turfgrass plant is also important. If the soil is not very moist, a fertilizer will have a proportionally increased effect on elevating soil solution's osmotic pressure

Watering in a fertilizer increases the volume of the soil solution. This beneficially reduces the osmotic pressure of the soil solution and helps move soil moisture and dissolved nutrients into root cells.

In well-drained soils, however, heavy water applications may also harm the plant by leaching nutrients past the root system. Different nutrient sources also have different rates of potential for leaching. For example, research in Florida has shown that fertilizer applications are exposed to stresses from any of several outside factors such as drought, heat or disease.

Sulfate of potash (SOP) leaches from the rootzone at about one-half the rate of potassium chloride.

Both air temperature and humidity influence a plant's water status and water requirements. That is, as air temperature increases, the plant requires more water. And as humidity decreases, the plant requires more water.

As the osmotic pressure of the soil solution increases, less water is available to the plant. Watering in a fertilizer may increase the water available to the root system by decreasing the osmotic pressure of the soil solution; but it may have the unintended effect of reducing the plant's water requirements by cooling the plant and increasing the humidity of the plant's micro-environment.

### Application rates

Soluble fertilizer materials may be used at any time of year with minimal risk of damage to turf, if the factors that contribute to burn are understood. The salt index of a fertilizer material is extremely important, especially when the fertilizer is highly soluble. The rates of application must be lower when a fertilizer with a high salt index is used.

Fertilizers with a low salt index should be used when soil test results indicate that the soil already contains excessive levels of soluble salts or when turfgrass stands receiving a fertilizer application are exposed to stresses from any of several outside factors such as drought, heat or disease. **LM**

Table 1

**Nitrate Salt Index**

| Material | Approx. % N | Avail-- ability | Salt Index | Salt Index per unit of N |
|---|---|---|---|---|
| Sodium Nitrate | 16 | Fast | 100 | 6.3 |
| Ammonium Nitrate | 33 | Fast | 105 | 3.2 |
| Ammonium Sulfate | 21 | Fast | 69 | 3.3 |
| Potassium Nitrate | 14 | Fast | 74 | 5.3 |
| Calcium Nitrate | 12 | Fast | 53 | 4.4 |
| Urea | 45 | Fast | 75 | 1.7 |
| IBDU | 31 | Slow | 5 | 0.2 |
| Ureaformaldehyde | 38 | Slow | 10 | 0.3 |
| Sulfur Coated Urea | 38 | Slow | | * |
| Natural Organic | 5 | Slow | 4 | 0.8 |

*The salt index for sulfur coated urea is the same as urea on a material unit basis, but the salt index is moderatd for SCU over a longer time period.

Table 2

**Salt Index Values for Other Fertilizers**

| Material | Approx. % N | Salt Index | Salt Index per unit of N |
|---|---|---|---|
| Superphosphate | 20% $P_2O_5$ | 8 | 0.4 |
| Muriate of Potash | 60% $K_2O$ | 114 | 1.9 |
| Sulfate of Potash | 50% $K_2O$ | 46 | 0.9 |
| Dolomite | 30% CaO | 1 | — |
| | 20% MgO | | |
| Gypsum | 33% CaO | 8 | 0.2 |
| Epsom Salts | 16% MgO | 44 | 2.7 |