Train your staff in their use

Make sure your team has read the leaflets. Your team must be providing the same story as the leaflet. If they provide a different story, you will end up confusing your customer and your team members will lose credibility.

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Anatomy of a Water-Soluble Fertilizer Label

By Cari Peters and Karen Kackley

By law and as described by the Association of American Plant Food Control Officials (AAPFCO), all fertilizer labels must contain the following information: the brand and grade, a guaranteed analysis, the net weight of the product, the name and address of the registrant/licensee, and directions for use.

These five components are carefully regulated through random product sampling and analysis by government laboratories as well as by manufacturer licensing and product and brand registrations according to the laws of each state or country.

Manufacturers may include additional information such as a "derived from" statement, the potential acidity or basicity of the product, use suggestions, safety information, and product codes. For this article we will split the anatomy of the fertilizer label into the five components above, plus the derived from statement and calcium carbonate equivalent (CCE).

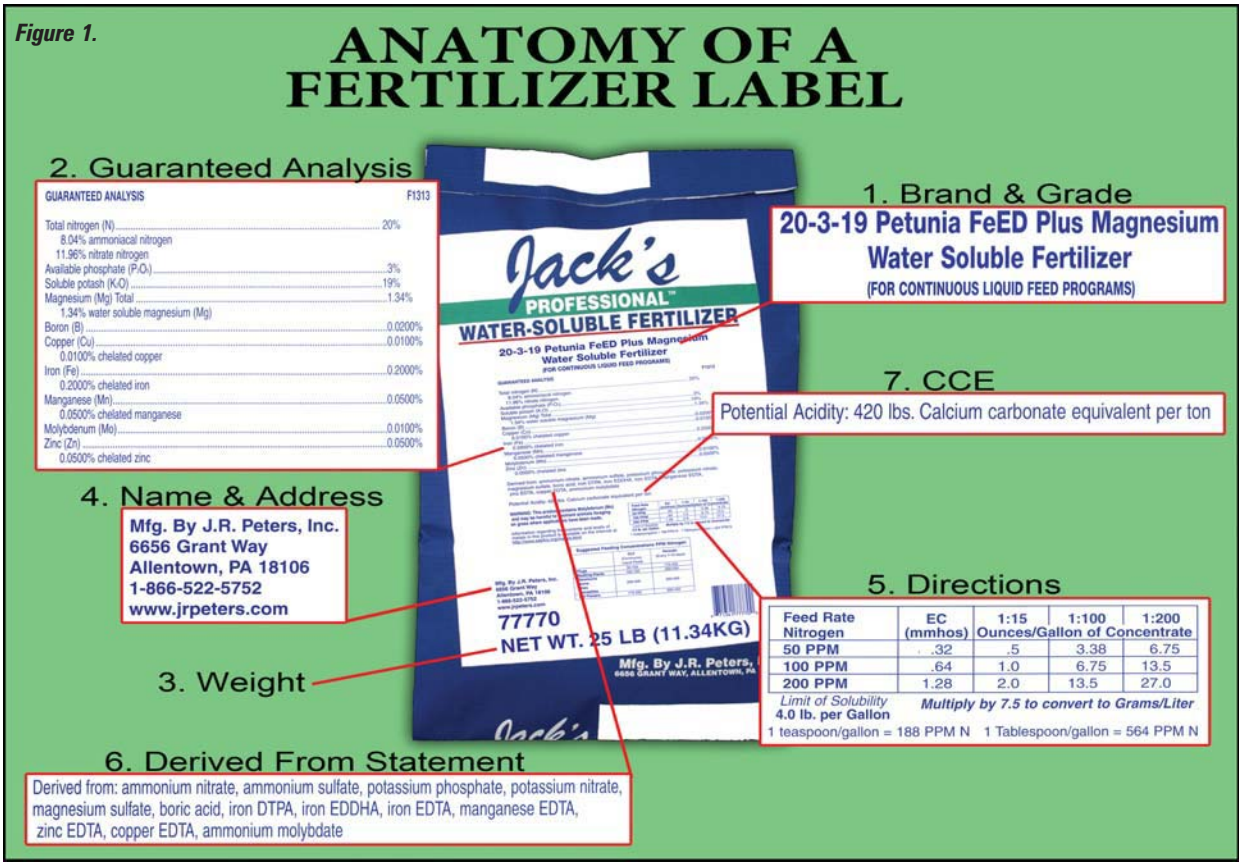
1. Formula Brand or Grade

The first thing you should note on a fertilizer bag is the formula brand or grade. This is the percentage by weight of total nitrogen, available phosphate (P_2O_5), and soluble potash (K_2O) contained in the product. These numbers indicate the minimum guaranteed percentage of the three most common fertilizer nutrients. Known as macronutrients, large amounts of nitrogen (N), phosphorus (P), and potassium (K) are necessary for plant growth. Additionally, a fertilizer's grade indicates its ratio, or the balance of these nutrients to one another. It is calculated by determining the proportions of the grade's major nutrients to each other. For example: 20-10-20 has a 2:1:2 ratio, meaning it's formula has twice as much nitrogen and potash as phosphate.

A Closer Look at the Macronutrients

The first number of the formula's grade represents the percent of elemental nitrogen. The second number

Figure 1.



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provides a measure of the amount of phosphate available to the plant and is the percent phosphorus expressed as an oxide (P_2O_5). The third number is the percent potassium also in oxide form (K_2O), often referred to as potash. Some labels include four or five numbers in the formula grade. The optional fourth and fifth numbers indicate the percentage of calcium and magnesium in the formula and are usually represented when a formula is designed to include a significant amount of these elements.

N%

Of the three macronutrients, nitrogen (N) is taken up by the roots in the greatest amount. The water-soluble nutrient sources of N include ammonium nitrate, ammonium sulfate, calcium nitrate, potassium nitrate, urea, and others. Many of these nutrients are used in varying combination to provide the plant with enough N to foster healthy vegetative plant growth. Nitrogen as nitrate (NO_3^-) is the most preferred form for plant uptake. Ammonium (NH_4^+) nitrogen is also taken up, but usually to a lesser degree since it is quickly converted to nitrate nitrogen under normal conditions. However, when low light and cool temperatures prevail, this process is slowed and ammonium can accumulate causing plant damage. Nitrogen can be absorbed by the plant roots or through foliar feeding. Recommended feed rates for CLF (continuous liquid feed) for most bedding plants vary between 100 and 250 ppm N depending on plant species. It is important to note that the form of nitrogen in a fertilizer can greatly affect the ability of a fertilizer to change medium pH. In general, nitrate nitrogen raises pH while ammoniacal nitrogen lowers pH. This attribute is discussed further in the CCE section below. Inadequate levels of nitrogen in plant tissue produces chlorosis of the lower leaves as the mobile nitrogen moves up to actively growing plant parts. As deficiency conditions persist, overall plant yellowing occurs and growth and reproduction are stunted.

P_2O_5%

The percent P_2O_5 gives you a measure of the percent available phosphate of a formula. Water-soluble nutrient sources of phosphate include ammonium phosphates, potassium phosphates, and urea phosphate. In order to convert the percent P_2O_5 to elemental phosphorus you divide the P_2O_5 percent by 2.3. Phosphorus is generally considered important for early root development and for increased flower bud set and color development. High phosphorus fertilizers, such as 9-45-15 Plant Starter, ensure that phosphorus is available for use during root establishment and 10-30-20 Blossom Booster helps promote continual blooming and deep flower color. Most plants prefer a N to P_2O_5 ratio of 2:1 or 3:1, such as 21-10-20 or 15-0-15. Formulas with a low phosphorus ratio like 13-2-13 can be used to regulate plant growth by reducing the plant's tendency to stretch or become "leggy." This can reduce overall use of chemical growth regulators. In addition, this proactive form of fertilizing helps reduce environmental concerns often associated with phosphorus runoff. Phosphorus deficiency can cause reduced growth and stunting; symptoms include abnormally dark green foliage and/or purple marks caused by an accumulation of anthocyanins that form when the plant is unable to convert sugar to starch.

K_2O%

The percent K_2O indicates the amount of soluble potash in the fertilizer. Water-soluble nutrient sources of potash include potassium nitrate, potassium phosphates, potassium chloride, and potassium sulfate. In order to convert the percent K_2O to elemental potassium, you divide the K_2O percent by 1.2. Potassium plays a role in plant respiration, cell water status, and is a major factor in the function of the plant's enzymes. Excess potassium can affect the availability of other nutrients (Mg, Ca, N) and can produce a build-up of soluble salts. Symptoms of potassium deficiency include yellowing of the lower leaves which can progress to marginal burn and necrosis. Similar to nitrogen, potassium is required by plants in relatively large amounts. Most all-purpose fertilizers contain a nitrogen to potassium ratio of 1:1. High potassium fertilizers promote sturdy, firm stem and leaf development, and can be used to reduce overly lush vegetative growth. Manipulating the nitrogen to potassium ratio specific to crop requirements can be a useful tool in growth regulation. For example, finishing fertilizers for chrysanthemum production often have elevated levels of potassium to harden off growth and increase stem strength for packing and shipping.

2. Guaranteed Analysis

All fertilizer bags must present an accurate guaranteed analysis. This is defined as the percent weight of the nutrients the formula claims to contain, except for % P and % K which are shown as % P_2O_5 and % K_2O respectively. Figure 1 (page 23) shows the required order and forms of the nutrients as they should be listed in the guarantee. Although they strive for uniformity, each state can set their own regulations and requirements for the guarantee to include or exclude micronutrients or other nutrient additives. Once a plant nutrient is guaranteed it will be subject to the rules and regulations of that state, including random sampling and laboratory analysis, to ensure the guarantee is met. Special considerations for minimum requirements are made for continuous liquid feed program (CLF), ready-to-use liquid fertilizer, and potting soils.

ofa Grower

3. Net Weight

By law, all formulas must be labeled on a net weight basis rather than package volume. This is because different nutrient components have varying bulk densities. The bulk-density of the formula can vary with changes in nutrient combination, particle size (ground vs. unground material), or the amount of water attached to a nutrient. For example, Orchid 30-10-10 is one the lightest formulas due to its high percentage of urea, one of the least dense nutrient compounds used in water-soluble fertilizers. It is common practice for many growers to refer to teaspoons or tablespoons per gallon of water when measuring small volumes. A standard conversion for nitrogen per teaspoon is 12.5 ppm N for each 1percent N in the formula. For example, if you mix 1 teaspoon per gallon of water of a 20-20-20 formula, you would be applying 250 ppm N to your plants.

The formula says 20-20-20 . . . what is the other 40%?

All labeled nutrients in a fertilizer formulation do not just exist as individual elements, they are attached with other elements through chemicals bonds. In a 20-20-20 formula, the 20 percent nitrogen comes from a combination of urea, ammoniacal nitrogen, and nitrate nitrogen. Each of these compounds contain a certain percentage of elemental nitrogen as well as other elements such as oxygen, carbon, and hydrogen. For example, a 25 pound bag of 20-20-20 contains 5 pounds of nitrogen, 5 pounds of P_2O_5, and 5 pounds of K_2O. Ten pounds of the total weight is contributed from carrier nutrients. One falsehood is that the remainder of the weight comes from a "filler" like sand – NOT TRUE! Most quality fertilizers have very little room to fit all the nutrients, especially for a tight formula like 20-20-20, when all the secondary and micronutrients are supplied in their desired percentages.

4. Name and address of the registrant/licensee

This section of the label is self-explanatory. It supplies the contact information for the manufacturer or the registered seller of the product.

5. Directions for use

While the AAPFCO regulations specify that a fertilizer label must provide directions for use, they do not specify the form those directions must take. Since most growers apply their fertilizer via injectors, water-soluble fertilizer manufacturers generally provide the directions for use in the form of injection tables. (Item number 5 in Figure 1, page 23). Note that this table consists of a column labeled "Feed Rate" in ppm N, a column labeled "E.C." in mmhos, and three columns of injector ratios. In order to use this injection table, you must know the desired concentration of feed in parts per million nitrogen (ppm N) and the delivery ratio setting of the injector.

Choosing the proper ppm N

Parts per million of nitrogen is a way of expressing fertilizer concentration. One ppm is equivalent to 1 milligram/liter (mg/l). While fertilizer manufacturers frequently place suggested feeding rate charts on the bag, it should be remembered that these are merely suggestions. It is up to the grower to select the proper fertilizer concentration. Some of the factors that affect this selection are the crop's requirements, the frequency of application, method of application (subirrigation vs. top watering), growing medium characteristics, and container size. The best way to ensure that the proper fertilizer concentration has been selected is to monitor the growing medium nutritional levels. If the soluble salts in the growing medium are accumulating to levels higher than desirable, the concentration of fertilizer should be reduced. Many plant propagators and suppliers now provide their recommended fertilizer concentrations in the desirable soluble salts or electrical conductivity levels in the growing medium vs. ppm N.

Injector settings

It is important to remember that an injector does not deliver a fixed ppm N. You must determine the amount of fertilizer to dissolve per gallon of water to make the appropriate concentrate for a specific injector setting. Most injectors have either a fixed injector ratio or some means of changing those ratio settings. Many have dual markings in percent and ratio. A 1 percent setting is the same as a 1:100 (read as one to one hundred) ratio. A 2 percent setting is the same as a 1:50 ratio, and a 0.5 percent setting is the same as a 1:200 ratio. There may be more possibilities depending on the injector manufacturer.

When you read a recommendation that is stated as "ounces (pounds, grams, etc.) per 100 gallons," remember that is the dilute strength of the fertilizer delivered to your plants. You must use that figure when determining how to mix a concentrate to use with your injector. The easiest way to do this is to set your injector ratio at 1:100 and dissolve the quantity stated "per hundred gallons" in each gallon of water for your concentrate. Each gallon will then be diluted into 100 gallons of water.

The proportioning ratios of Hozon-type proportioners fluctuate depending on the water pressure and flow. The ratios vary between 1:12 and 1:16. Most manufacturers' calculations assume an average ratio of 1:15 for these proportioners.

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Remember that technical representatives of the fertilizer companies and university personnel can help fine-tune your calculations.

Reading the Chart

Once you have selected the desired fertilizer concentration and injector setting, all you have to do is read the chart. For example, if you desire a 200 ppm nitrogen solution of 20-3-19 and the injector is set to 1:100, read down the column on the left to 200 ppm and then across to the 1:100 column. The box at the intersection of these two lines contains the number 13.5. This means that to obtain a 200 ppm N solution of 20-3-19 at an injector setting of 1:100, you dissolve 13.5 ounces of fertilizer per gallon of concentrate. This is 13.5 ounces by weight. As noted previously, volumetric measurements are problematic. Not all coffee cans or 4-inch pots contain the same volume, and not all fertilizers have the same weight per volume. To measure an accurate volume of fertilizer, check the amount by weighing out that volume periodically on scales.

The EC column

Fertilizer manufacturers should provide information on the soluble salts or electrical conductivity (EC) readings that correspond to ppm N levels of feed. This allows you to check the concentration of the fertilizer solution. Solution color is not a reliable gauge for fertilizer strength. Use a good conductivity meter that reads in millimhos per centimeter (mmhos/cm) or deci-Siemens per meter (dS/m). These two units of measurement are equivalent. Make sure to add the EC of your raw water to the number expected from your fertilizer to determine your target EC. For example, a 200 ppm solution of 20-3-19 should have an EC of 1.28. That number should be added to the EC of the raw water. If the raw water has an EC of 0.56, you would expect an EC of 1.84 (1.28 + 0.56). If you add two fertilizers together, add their corresponding ECs to the water EC and use that number as your target. It is important to note that additions of other components such as acids or Epsom salts also contribute to the EC of the solution.

6. The Derived from Statement

Growers should read product labels and understand exactly what is in the bag they are buying. The "Derived From" statement lists the sources of the nutrients. Some products utilize less expensive nutrient sources that contain harmful elements such as sodium and chlorides. High levels of these undesirable fertilizer salts can cause plant injury, so products that contain them should generally be avoided. Ingredients like muriate of potash (potassium chloride) and nitrate of soda (sodium nitrate) that contain a high amount of chloride or sodium may be harmful when used continually, especially if the irrigation water itself contains excesses of these ions.

Unfortunately, many water-soluble fertilizer labels/formulas appear to read the same. However, what sets fertilizers apart is the quality or grade of the raw materials used. Using a higher grade (pharmaceutical grade) raw material ensures total or maximum water solubility. To check the water solubility, place some of the fertilizer in water in a clear container and stir. It should completely dissolve with no sediment on the bottom of the container. This means the fertilizer is in true solution and can be taken up immediately by the plant.

7. CCE (calcium carbonate equivalent) or potential acidity/basicity

Although it is not a requirement, a potential acidity or basicity rating usually is listed on each bag of water-soluble fertilizer. This is a calculated value which indicates the ability that particular fertilizer has to either raise or lower the pH of the soil solution over time. Fertilizers that have the potential to lower the pH are listed as acidic, and those that have the potential to raise the root medium pH are listed as basic.

The concept of fertilizer potential acidity or basicity has been around since the 1940s when greenhouse crops were grown in field soil. While the concept is less important today when most crops are produced in soilless mix, it is still a useful tool to compare fertilizers. This value is determined largely by the amount and the sources of nitrogen in a formula. Fertilizers that contain more urea and ammoniacal nitrogen are acidic in reaction, while those that contain primarily nitrate nitrogen are basic.

The numbers used to express these potentials refer to the pounds of limestone (calcium carbonate) that it takes to either neutralize (potential acidity) or be equivalent in reaction to (potential basicity) one ton of that fertilizer. The larger this number, the greater likelihood that the medium pH will be affected. For instance, calcium nitrate has a potential basicity of 400 pounds CCE (calcium carbonate equivalent) per ton. Theoretically, this means that an application of one ton of this fertilizer should have an effect equal to the application of 400 pounds of limestone. It is not the absolute value that is important, but the general location within the spectrum of acidity or basicity. For example, one brand of 20-10-20 may list a potential acidity of 410 pounds while another lists 425 pounds. This difference is insignificant. Yet the difference between 20-10-20 at 410 lbs of acidity and 15-5-25 with an acidity of 50 pounds is significant.

In theory, if you alternate (or combine) fertilizers having opposite potentials with the same number, you should be able to stabilize your medium pH. In reality, you should carefully monitor your pH since the medium is a dynamic system and is influenced by many other factors, such as irrigation water alkalinity, growing medium additions, fungicide drenches, and root exudates.

Do not confuse potential and active acidity or basicity. The active acidity or basicity of a fertilizer is how the fertilizer reacts in water. In general, most fertilizers do not significantly change the water pH. Exceptions to that rule include fertilizers containing urea phosphate or citric acid. The most common method of adjusting the active acidity or basicity of a solution is via the addition of mineral acids or bases such as bicarbonates.

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Transitional Duty Program

By Gary Hanson

One of the steps in the "Nine Key Safety Program Parameters" requires companies in the Workers Compensation Group Rating Program to develop and implement a Transitional Duty Program. Although this may be difficult for some companies, there are some good basic business reasons why this makes good sense.

The Ohio Bureau of Workers Compensation (BWC) uses a formula system when determining how much to reserve against a particular claim. It does not matter what type of injury; what matters is the length of time an employee is off work, how much Temporary Total Disability (TTD) is paid out and when the employee is off work. Very high reserves can be set on claims that may not appear to be that serious. I have seen hernia claims with a max value reserve placed on them.

When establishing a reserve the BWC first looks at the amount of TTD paid on that claim. To set the reserve they then use a factor which could be up to five times what was actually paid during the claim year and then multiply this times TTD paid. If the employee is off past April 1 of the next year, or goes off in the new claim year, the reserve factor can increase dramatically. As an example, take an employee with a hernia in August who is off work for six weeks. His weekly TTD is $450. The BWC will pay the employee $2,700 during this period, plus any medical expenses. If there is no additional activity on this claim, the reserve in the claim could easily be close to $16,000 dollars.

Take the same type of claim but the injury happens in December and the employee is capable of working until mid February, before he goes off. He stays off six weeks and comes Back to work in March. December 31 is the cut-off date for determining reserves from the previous year. Since this claim went past December 31, the reserve could be significantly higher than in the previous example. In some cases the reserves can go up to the max value for your size of company.

These reserves determine a company's experience rating. The higher the reserves the higher your loss ratio for the four-year rating period. If your *modified loss ratio* is higher than the expected losses or limited losses for your size and type of company, your company will be penalty rated. This could cause a company to be removed from the Group Rating Program or be denied entry into a group.

One way to avoid these large reserves is to provide an aggressive Transitional Duty Program. The less time an injured employee collects temporary disability payments, the lower the reserve that is placed on that claim. I have heard from some employees that they do not want to pay someone who is unable to perform his regular duties. In the past this had been standard argument. The fact is, if the employee is collecting TTD from the BWC, you will be actually paying much more. A Transitional Duty Program actually saves money and, in many cases, speeds up the recovery process.

If you have not established a program yet or are in need of assistance in writing one, the following is a sample program that you may wish to use. Please feel free to make any modifications you feel necessary.

Sample Transition Duty Program

Every effort will be made by our company to provide a safe and healthful work environment for all employees. However, from time to time there may be the possibility of employee injury. If that happens, the employee will be transported to the nearest emergency medical facility for proper treatment. The employee will be returned to work after treatment, if possible.

In the even an employee is injured but cannot return to regular duty immediately, a Transitional Day Duty Program has been established. This program is designed to get valuable employees back to productive work as soon as possible following an injury. Work requirements will be keep within any physical work limitations placed on the employee by his/her treating physician.

The company will work closely with our injured employee and their treating physician. The treating physician will be notified of our Transitional Duty Program and our desire to work wit the physician to return our injured employee to productive employment in an expeditious manner. We will request a list from the

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