IPNI
Plant Nutrition **TODAY**
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 1

FERTILIZER USE AND HUMAN HEALTH

Once again, food prices have been climbing. A growing human family seeks more and better food. Farmers, already under pressure to reduce impact on the environment, are pushed to produce more. Responsible stewardship of plant nutrition has never been more important.

The issue of food security comprises more than just quantity. Quality is just as crucial. Plant nutrition impacts both, ensuring that plant products nourish people. To meet the nutritional needs of expected population growth, global cereal production is forecast to increase by 70% by 2050. Important components of these nutritional needs include carbohydrates, proteins, oils, vitamins, and minerals. Plant nutrition affects them all.

Many of the healthful components of food are boosted by the application of nutrients. Since most farmers already fertilize for optimum yields, these benefits are easily overlooked. Applying N to cereals adds to the protein they produce, as well as their yields. Phosphorus, K, and S enhance the biological value of the protein in potatoes. Trace elements important to human nutrition, especially zinc, selenium, and iodine, can be optimized in the diet by applying them to food crops. Plant nutrition can impact the plant diseases that cause degradation of food products and mycotoxin risks.

Where rice is the most common staple and where intake of milk products is low, calcium deficiency can be quite common. Broccoli and soybeans are examples of plants that can contribute calcium and magnesium to the human diet. When crops like these are grown in acid soils of limited fertility, applying lime can boost the levels of these minerals. Applying K can increase the K concentration of fruits and vegetables, along with qualities like sweetness, texture, color, vitamin C, beta-carotene, lycopene, and folic acid contents.

Fertilizer use can also be associated with a number of negative factors that need to be properly understood and managed. For decades, nitrate in drinking water has been a concern. While new evidence shows a positive role for nitrate in cardiovascular health, and the occurrence of methemoglobinemia has been rare in developed countries, questions remain regarding its potential relation to carcinogenic nitrosamines. More recent questions have arisen as to whether ammonia emissions from fertilizer could contribute to the formation of unhealthy levels of smog. Eutrophication leading to harmful algal blooms has been attributed in many places to losses of agricultural nutrients.

Even though questions remain regarding the degree to which agricultural nutrients are responsible, it must be acknowledged that the perturbations arising from the globally unprecedented, large-scale increase in the use of fertilizer in the past 50 to 100 years are worthy of careful attention and study. Those engaged in research and development for cropping systems recognize the multiple benefits of increasing nutrient use efficiency, and have already made considerable progress in reducing surpluses and losses of nutrients. Continued progress is needed to ensure optimum human health on both sides of the equation: the provision of adequate quantities of nutritious food, and the avoidance of harm to the environment upon which all life depends.

Responsible nutrient stewardship has great potential to continue providing benefits to the health of humanity. Working with the International Fertilizer Industry Association (IFA), the International Plant Nutrition Institute (IPNI) plans to release a scientific publication on fertilizer use and human health in the coming year. It will provide details on the impacts mentioned above, and on many more. The intent is to inform the industry, correct misperceptions with a credible science-based approach, and to invite constructive contributions from science toward enhancing the benefits and resolving the issues.

– TWB –

For more information, contact Dr. Tom Bruulsema, Northeast Director, IPNI, 18 Maplewood Drive, Guelph, Ontario N1G 1L8, Canada. Phone: (519) 821-5519. E-mail: Tom.Bruulsema@ipni.net.

Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur.

Note: ***Plant Nutrition TODAY*** articles are available online at the IPNI website: www.ipni.net/pnt

IPNI
Plant Nutrition **TODAY**
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 2

"SHOW ME" AND FERTILIZER APPLICATIONS

Does the fertilizer you apply always give the result you expected? Farm customers want to know that the fertilizer they apply is resulting in a yield increase.

Of all fertilized crops, it is my observation that we have more questions about whether the fertilizer applied worked or not when applied to forage stands. I'm not certain why this is, but perhaps it is because whether a forage crop is grown for grazing, hay, or silage, it is more difficult to measure yield increases due to fertilizer compared to grain crops, especially when the stand is grazed. Soil testing is often used as a first step in deciding which nutrients to apply and the rate of application of each nutrient. These recommendations are usually based on regional fertilizer response trials targeting normal yields for the area.

About 10 years ago while I was working as an agronomist out of Calgary, AB, assisting wholesale customer agronomists in western Canada, I received a phone call one late February from a customer and friend. He was the manager of Interior Seed and Fertilizer Ltd., a dealership in Cranbrook, BC, and asked me to consider conducting a fertilizer response trial on an irrigated forage field of a ranch customer. After checking with our field research group for the availability of a plot forage harvester, I agreed to devote the time and resources to assist with the trial.

The ranch customer thought that fertilizer response was disappointing on fields used for a combination of hay and grazing. They usually fertilized in early spring, took the first cut as hay, and grazed the re-growth in late summer or early fall. The ranch owner had said: "*I just don't think the fertilizer you apply for us really results in much increase in forage growth. How can you **'Show Me'** that your fertilizer works?*" The customer had soil testing done at least every few years, and the recent results showed N as deficient, P and K as marginal, and S and B as adequate. The irrigated field was estimated at having a 25% alfalfa and 75% forage grass stand, and the target forage yield was 3 tons/A. The actual nutrients applied per acre were 40 lb N, 30 lb P_2O_5, 40 lb K_2O, and 15 lb S.

We designed and conducted a simple fertilizer response trial using an omission technique. This requires having a plot where each one of the nutrients being evaluated is omitted on a plot while all the other nutrients are applied. There is one plot that receives all the nutrients. If there is no decrease in yield when a nutrient is omitted compared to the all nutrient plot, it is assumed that sufficient amounts of that nutrient are being supplied from the soil. Additionally, there is a check plot where no fertilizer is added at all. We repeated each individual 6.5 ft by 13 ft (2 m by 4 m) size plot four times using a randomized block design, so we could analyze the results statistically. We evaluated the forage yield response rates of 50 lb N, 40 lb P_2O_5, 100 lb K_2O, 20 lb S, and 1 lb B per acre.

The two-cut total forage yield results clearly showed that there was a response to N; all other nutrients did not show a clear response compared to the complete blend or the no-fertilizer treatment. There was a slight average yield decrease when each nutrient was omitted compared to the complete blend.

After the study was completed, we sent a final report to the customer, stating that we could definitely conclude that there was a response to fertilizer. We felt this would **"Show Him"** there was benefit…a direct benefit to N and that P, K, and S application would maintain availability for future crops.

We wouldn't recommend running this type of trial for every customer who questions whether or not they are getting a response to fertilizer. A soil sampling, soil analysis, and recommendation done by a retail fertilizer dealer probably costs around $300 if you consider retail staff time involved, equipment, and laboratory analysis charges. The field trial we conducted cost close to $3,000 when considering labor, plus travel costs taking research equipment to the ranch. So, it cost 10 times as much to conduct a **"Show Me"** field demonstration. Fortunately, there has been past investment in regional fertilizer trials in most agricultural regions that we can refer to, in order to estimate the yield response for most crops from added nutrients. My conclusion is that the soil testing and recommendation system we have available to us is very cost effective.

– TLJ –

For more information, contact Dr. Thomas L. Jensen, Northern Great Plains Director, IPNI, 102-411 Downey Road, Saskatoon, SK S7N 4L8. Phone: (306) 652-3535. E-mail: tjensen@ipni.net.

Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur; B = boron.

Note: ***Plant Nutrition TODAY*** articles are available online at the IPNI website: www.ipni.net/pnt

IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 3

WHERE DOES POTASH COME FROM?

Maintenance of an adequate K supply in the soil is essential for sustaining global food supplies. Many soils need an additional source of K to supplement the native minerals in order to meet this minimum requirement. Crops remove large amounts of K from the soil in the harvested portion. At some point, it is necessary to replenish the supply of this nutrient.

Potassium fertilizer (commonly called potash) is mined from underground deposits in many parts of the world. Canada is the largest producer of potash fertilizer, followed by Belarus, Russia, and China. The potash ore is extracted from depths exceeding one-half mile below the earth's surface.

The potash ore is first crushed and washed to remove any clay or minerals that may be present. Some potash ore contains iron that imparts a red tint to the final fertilizer. The sodium salts are next separated and removed from the potash. The potash particles are then compacted to achieve the desired size for convenient handling and spreading.

A few naturally occurring surface-water brines (such as the Great Salt Lake in Utah and the Dead Sea bordering Jordan and Israel) contain sufficient K to make potash extraction feasible. Solar evaporation is used to concentrate the salts, which are washed to separate the K salts from the sodium salt.

Potassium has many important functions in plants. Perhaps the most noted roles are for regulating plant water relations, activating enzymes, and promoting protein formation. Potassium also plays a significant role in improving the quality of the harvested plant products and enhancing disease and insect resistance.

The finished potash fertilizers are important global commodities that are transported across the world. China is the largest potash consumer, followed by the USA, India, and Brazil. There are many excellent potash fertilizers available; the selection depends on the agronomic need of the crop. The K portion of all potash fertilizer is identical, the difference being the anion present. The most common fertilizers include: Potassium Chloride (KCl); Potassium Sulfate (K_2SO_4); Potassium Magnesium Sulfate ($K_2SO_4 \cdot 2MgSO_4$); and Potassium Nitrate (KNO_3).

The results of regular soil testing and consultation with a local Certified Crop Adviser (CCA) will provide guidance on how to best manage the K supply for your crops. The next time you apply potash fertilizer, consider the complex journey that it took to get those nutrients to your plants.

A visual tour of the potash production process can be seen at this URL: **http://info.ipni.net/potashtech**

– RLM –

For more information, contact Dr. Robert Mikkelsen, Western North America Director, IPNI, 4125 Sattui Court, Merced, CA 95348. Phone: (209) 725-0382. E-mail: rmikkelsen@ipni.net.

Abbreviations: K = potassium.

IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 4

HOW DOES ONE pH COMPARE TO ANOTHER?

Soil pH. It is one of the most important chemical properties that affect nutrient interactions in soils and plants. It is, however, one of the most misunderstood measurements, particularly when comparing one pH value to another.

A question that is often asked is, “How many times more acid is one pH than another?” This question is not so straightforward to answer, because pH is not on a linear scale, like a ruler. Instead, it is on a negative log scale. Soils that are higher in acidity actually have smaller pH values, thanks to the negative log scale. The pH scale goes from 0 to 14. The 0 end of the scale is more acid. The 14 end is basic, and a pH of 7 is neutral, dividing acidic from basic. So we know that a pH of 5.8 is more acid than a pH of 6.6. But how many more times acid is it?

To get at the answer to this question, we must first recognize that pH is a transformed measure of the concentration of acid. To find out “how many more times acid” one pH value is than another, we have to do some mathematical manipulations to get us out of the negative log scale and back to a linear scale where such comparisons make sense.

The table below was developed from these mathematical manipulations and is provided to allow you to quickly determine how many times more acid a lower pH value is than a higher one. To use the table, take the higher pH value and subtract the lower one. Look up the difference in the table, under the heading “pH difference.” Then look at the corresponding number in the column to the right labeled “Times more acid.” Using our example, we want to compare pH 5.8 and 6.6. We take the higher value and subtract the lower one: 6.6 – 5.8 = 0.8. When we look up 0.8 in the table, we get 6.3. So the lower pH of 5.8 is 6.3 times more acid than the higher pH of 6.6. Using this table, you can easily determine how two pH values compare to one another, up to a difference of 3 pH units. For a more complete set of units, visit >**http://nanc.ipni.net/articles/NANC0022-EN**<.

pH difference	Times more acid	pH difference	Times more acid	pH difference	Times more acid
0.1	1.3	1.1	13	2.1	126
0.2	1.6	1.2	16	2.2	158
0.3	2.0	1.3	20	2.3	200
0.4	2.5	1.4	25	2.4	251
0.5	3.2	1.5	32	2.5	316
0.6	4.0	1.6	40	2.6	398
0.7	5.0	1.7	50	2.7	501
0.8	6.3	1.8	63	2.8	631
0.9	7.9	1.9	79	2.9	794
1.0	10.0	2.0	100	3.0	1000

– TSM –

For more information, contact Dr. T. Scott Murrell, Northcentral Director, IPNI, 1851 Secretariat Dr., West Lafayette, IN 47906. Phone: (765) 413-3343. E-mail: smurrell@ipni.net.

IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 5

THE TRUTH ABOUT PEANUT FERTILITY IN THE SOUTHEAST

With peanut demand up and contract prices considerably higher than in recent years, growers in the Southeast are looking at ways to maximize production. One area of production that is getting a lot of attention is plant nutrition, specifically fertilizer inputs. To be most profitable, it is important not to over-apply fertilizer nutrients; however, failing to apply adequate amounts of the required nutrients can result in crop yield reductions and monetary losses. This article will address some of the common perceptions about peanut fertility that exist in the Southeast, some of which are true, some are false, and some could be considered "true-ish", meaning that the original concept was based on fact, but is being perpetuated out of context.

"Peanuts remove as much P and K as other crops traditionally grown in the Southeast" is a TRUE statement. A 2-ton/A peanut crop will remove approximately 22 lb P_2O_5 and 34 lb K_2O/A. Comparatively, 2-bale cotton will remove 28 and 34 lb P_2O_5 and K_2O/A, respectively, while a 30-bu/A soybean crop removes 24 lb P_2O_5 and 42 lb K_2O/A. Most of these nutrient needs are met through fertilizer inputs. Over time, continued removal of soil nutrients without replacement will cause soil fertility to decline and yield losses will occur.

What is interesting considering the nutrient removal similarities is that the statement "Peanuts do not require soil P and K levels as high as cotton or corn for optimum yield" is also TRUE. In soil testing, the nutrient concentration that separates responsive and non-responsive conditions is known as the "critical level". As soil test P or K falls further below the critical level for a given crop, the probability of a yield increase as a result of fertilizer additions becomes greater. In most states in the Southeast, peanuts have a considerably lower critical level for P and K than other crops typically grown in rotation with peanuts, which indicates that peanuts are more effective at utilizing or "scavenging" soil nutrient resources.

However, the statement "Peanuts are an excellent scavenger crop and do not respond to direct applications of P and K" is only TRUE-ISH. It is true that if soil test P and K were adequate for a preceding corn or cotton crop, it is unlikely that the subsequent peanut crop will respond to additional fertilizer applications. However, if the soil test indicates that P or K is below the critical level for peanut production (which may differ from lab to lab for various reasons) a direct fertilizer application to the peanut crop would be in order.

The statement "Southeastern universities do not recommend directly fertilizing peanuts", when taken literally, is also just TRUE-ISH. This statement is only true in the proper context. In the case of P, most agricultural soils in the region do not test below the critical level for peanut production; thus recommendations for P applications to peanuts are quite rare. So technically, it is true that universities are not recommending P fertilizer be applied to peanuts. However, the lack of recommended P fertilizer is based on soil testing, not a general rule nor opposition to the practice. Some state guidelines do suggest that K recommended for a peanut crop be applied with the fertilizer for the preceding crop to avoid potential competition with Ca uptake at pegging. These same guidelines also state that if the recommended K did not go out with the preceding crop, it should be applied prior to planting the peanut crop. University extension specialists agree that while Ca-K interactions are a potential problem, they do not discourage growers from making K fertilizer applications when needed. They do, however, advise growers in this situation to be sure not to cut back on their gypsum ($CaSO_4 \cdot 2H_2O$) applications.

Finally, the idea that "Universities in the Southeast do not support fertilizing peanuts" is absolutely FALSE. All universities and private labs in the Southeast have established guidelines for fertilizing peanuts and do make fertilizer recommendations when needed. It is widely accepted throughout the region that fertilization of other crops grown in rotation with peanuts will eliminate the need to apply additional P and K to the peanut crop. However, what is often forgotten is that the fertilization of the rotational crops needs to be in accordance with locally established, soil test-based recommendations. Otherwise, the peanut crop could be at risk for yield loss. Regarding peanut fertilization in the Southeast, a well-known university extension specialist says it this way, "If the soil test calls for it…apply it. End of story."

–SBP–

For more information, contact Dr. Steve Phillips, Southeast Director, IPNI, 3118 Rocky Meadows Rd., Owens Cross Roads, AL 35763, Phone (256) 529-9932. E-mail: sphillips@ipni.net.

Abbreviations: P = phosphorus; K = potassium; Ca = calcium.

Note: ***Plant Nutrition TODAY*** articles are available online at the IPNI website: www.ipni.net/pnt

IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 6

CROP NITROGEN USE EFFICIENCY—HOW HIGH IS YOUR HURDLE?

Past research indicates that on average, about 35 to 45% of the N applied (as fertilizer and/or manure) is recovered in the above-ground portion of the targeted crop during the year/season of application. Does that mean all the remainder is lost to the environment? No! A large portion may be retained in the soil in organic matter, on soil cation exchange sites, and also in root systems and crop residues.

With good management and available technologies, it is possible to raise the above-ground crop N recovery into the 60 to 70% range or more on most farms and fields. In the future, the hope of many agronomists is to see this range of recovery raised to an even higher level by coupling crop varieties and hybrids that have improved N recovery and physiology characteristics with skillful field N management.

What limits crop N recovery improvement in most fields? The first answer would probably be the weather. Although unpredictable weather is a big factor, there are opportunities in every field and on every farm to hedge against weather impacts and to lower the risks of N loss in retaining more in the crop and in the field.

Here are some examples of things one could do to help optimize N management:

Account for
- the supply of N released from microbial mineralization of soil organic matter,
- residual soil nitrate N when choosing a fertilizer N rate,
- any history of manure application and N released,
- crop N uptake demand and the seasonal uptake pattern.

Consider
- the balance between N applied from all sources and the crop harvest removal,
- how well the fertilizer N source is suited to your soils and crops,
- better synchronizing the timing of application to more closely match crop uptake demand,
- the risks for N loss via leaching/drainage, runoff/erosion, gaseous loss as ammonia, and gaseous loss due to denitrification during wet or waterlogged conditions.

If you have doubts or lack knowledge about any of these bulleted items, seek the advice of a Certified Crop Adviser, experienced fertilizer dealer, or Extension agent. A close evaluation of your N management plan might expose some of the hurdles present in your operation that may be limiting your crop N recovery. You might be surprised at the economic losses of N that could be occurring in your fields, and the risks the losses pose to water quality in your watershed and to the atmosphere. Fine-tuning your crop N nutrition program can enable you to clear the hurdles that may be exposed and provide improved returns on your fertilizer N investment.

What will you adjust in 2011 to get more profitability from your fertilizer N management?

– CSS –

For more information, contact Dr. Clifford S. Snyder, Nitrogen Program Director, IPNI, P.O. Box 10509, Conway, AR 72034-0008. Phone (501) 336-8110. Fax (501) 329-2318. E-mail: csnyder@ipni.net.

Abbreviations: N = nitrogen.

IPNI
Plant Nutrition TODAY
Better Crops, Better Environment...through Science

From Scientific Staff of the
International Plant Nutrition Institute (IPNI)
3500 Parkway Lane, Suite 550
Norcross, Georgia 30092-2844 USA
Phone: 770-447-0335 Fax: 770-448-0439
E-mail: info@ipni.net Website: www.ipni.net

Spring 2011, No. 7

COTTON NUTRITION AND FERTILIZATION

Cotton has made quite a comeback over the past few months with steep, and at times extreme, price increases in 2010. Prices are expected to remain relatively strong through 2011 as stocks should be tight. As a result, cotton acres may increase in some regions this year. A major factor affecting both cotton yield and quality is the availability of adequate and balanced nutrition. Given the optimism, now is a good time to review some cotton fertility basics.

Nitrogen is essential for the development of shoots, buds, leaves, roots, and bolls. Cotton takes up about 60 lb of N for each 480-lb bale produced, though it should be noted that N uptake figures can vary. Uptake is limited early in the season prior to squaring, and the majority of N is taken up after first bloom. Therefore, split applications of N improve the chances of meeting the crop needs during peak demand periods. A general recommendation is to provide about 10 to 20% of the crop N needs before bloom, and apply the remainder during the boll development period. Texas Tech University research has shown that on the Texas South Plains about 5 lb of N would be required per inch of water consumed. Since cotton is an indeterminate perennial, too much N late in the season may cause excessive vegetative growth and should be avoided. Soil and petiole tests can be helpful in determining preplant and midseason N management.

Phosphorus is important in early root development, photosynthesis, cell division, energy transfer, early boll development, and hastening of maturity. About 25 to 30 lb of P_2O_5 is taken up per bale of cotton produced. Placement of P fertilizer is not as important as in the production of some other crops. However, banding P can be advantageous in some situations (e.g., reduced or no-till, compacted soil conditions). Insufficient P results in dwarfed plants, delayed fruiting and maturity, and reduced yield. Use soil tests to determine optimum P application rate.

Potassium is an especially important nutrient in cotton production. It reduces the incidence and severity of wilt diseases, increases water use efficiency, and affects fiber properties like micronaire, length, and strength. It is important in maintaining sufficient water pressure within the boll for fiber elongation. Cotton utilizes about 60 lb of K_2O per bale. The need for K increases dramatically during early boll set, and about 70% of uptake occurs after first bloom. Potassium deficiency may be expressed as a full season deficiency, or it may not appear until late season since this is the period of greatest demand. A shortage of K reduces fiber quality and results in plants that are more susceptible to drought stress and diseases. Preplant applications of K fertilizer, and in some cases mid-season foliar applications, are effective in correcting deficiencies. Soil testing is the first step in predicting K needs.

Secondary elements and micronutrients may also be critical to profitable cotton production. For example, cotton responds to trace elements such as zinc and boron where these nutrients are deficient. Soil tests, plant analyses, field history, and experience should be considered when establishing the need for these elements.

Good nutrient management results in higher cotton yields, improved fiber quality, greater water and nutrient use efficiency. So, in this year of optimism make sure that fertility doesn't limit cotton production.

– WMS –

For more information, contact Dr. W.M. (Mike) Stewart, Southern and Central Great Plains Director, IPNI,
2423 Rogers Key, San Antonio, TX 78258. Phone: (210) 764-1588. E-mail: mstewart@ipni.net.

Abbreviations: N = nitrogen; P = phosphorus; K = potassium.