The Analysis

Agronomic Information From
Spectrum Analytic Inc.

Winter 2012

Mother Nature once again gave us some surprises in the growing season this year. We started out with the warmest March on record, I heard of a few corn fields being planted as an experiment. But I never did hear what the end results were from the effort. Most people held off planting until April and the crops went in once again in record time. The summer continued with warm temperatures and adequate rainfall and then in June rainfall amounts go to almost nothing and most areas of the Midwest experienced a drought. We did not include any articles about drought and soil sampling or soil test levels because it would be after the fact and most people are likely tired of reading about it from all the earlier publications. Scott wrote an article about nitrogen that we hope will help you in your nitrogen management decisions next spring.

In some areas of the country there is increased interest in deep banding of fertilizers. These bands can affect soil test levels and we need to take their location into consideration when putting the probe into the ground. The problem is that most of us do not know the location of these bands and therefore are likely to hit one. We have put some guidelines together to help you make decisions on how to take samples in banded fields.

We are now offering the Solvita soil test. This test was first introduced to the market place in late winter of 2010. There is limited research regarding calibration of the test for making nitrogen recommendations; however Woods End Lab and several university soil scientists are doing research to calibrate the test and make it more useful for the agricultural market. We have put an article of our own in this newsletter to help introduce this test to you. For the latest information, consult the Solvita website (www. http://solvita.com/).

All the employees at Spectrum Analytic wish you and your employees and their families a Blessed and Merry Christmas. We hope that everyone enjoys the holidays together with friends and family and that everyone travels safely. In 2013 we will be facing new challenges once again, take these challenges and convert them into an opportunity. May the New Year be successful to you and all your business ventures.

Who To Contact...

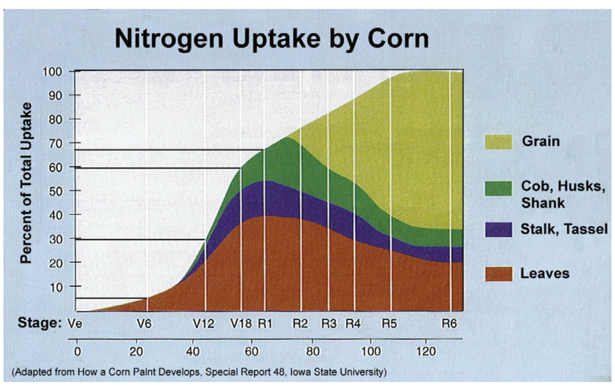
Agronomy ....Scott Anderson
Bill Urbanowicz
Computer ....Wayland Reid
Chief Chemist ....Vernon Pabst
Sales/Marketing ....Mike Hall
Billing ....Donna Scott
Fertilizer & Feed ....Vernon Pabst
Lab Technicians ....Randy Johnson
Jim Armstrong
Wayne Jinks
Cynthia Cook
Justin Stich
Sue Sunderhaus

What's Inside...

A Word of Caution About Predicting Nitrogen Carryover After a Drought Year

By Scott Anderson

Many of us experienced one of the worst drought years in recent memory in 2012 and there have been numerous articles written on what effect this might have on nitrogen carryover for 2013. Some of these articles about N carryover were written in the Great Plains States, where the lower annual rainfall makes predictions about N carryover somewhat more accurate. But, for the majority of Corn Belt farmers it isn't as simple as that. It would be great if we could give a simple formula that calculated the exact amount of N carryover in a field based on N applied minus N removed and adjusted for things like soil organic matter, typical carbon residue, etc., but agronomists can't really do that very accurately for most fields. The problem is that Mother Nature gets in the way. One of the biggest problems is that we cannot predict the rainfall between harvest and the main nitrogen demand period next season. At harvest time in 2012 essentially all the N in the field was in the nitrate form (NO_3). Nitrate is the form of N that is subject to the major loss factors of leaching and denitrification. If your soil is sandy, then leaching is a concern, while on clay soils denitrification is the more likely N-loss factor. One of the challenges in corn production is to have a sufficient amount of N for the "grand growth" period starting around V7 or 8 and keep a sufficient amount until the V 18 stage when uptake begins to level off. See the chart for a better idea of the "grand growth" period.



Leaching is simply the downward movement of N and it can occur at any time there is excess rainfall, but again, it isn't normally a major factor in the typically heavier Corn Belt loam and clay soils. Denitrification is a function of bacterial action in saturated soil where bacteria that require oxygen cannot get that oxygen from the soil atmosphere. Some of these bacteria have the ability to rob the oxygen from the nitrate molecule. This results in the formation of gaseous N (N_2), which escapes from the soil into the atmosphere. Since bacterial action is required for denitrification, it isn't as likely in cold soils, but the major time of N demand in corn is well into the summer, so denitrification of any carryover N has plenty of time to occur between spring warm up and ear formation next year. With excess rainfall most loam or clay soils will experience some, or a lot of denitrification in the spring and early summer. How much denitrification might occur depends on the amount of time a soil is saturated and the soil temperature.

Rates of Denitrification in Saturated Soils		
Soil Temp.	Days Saturated	Loss Of Applied N
55 - 60 F	5	10%
	10	25%
75 - 80 F	3	60%
	5	75%
	7	85%
	9	95%
(From Shapiro, University Of Nebraska)		

How quickly the soil becomes saturated, and how long it stays saturated is affected by the amount of clay in the soil, the amount of soil compaction, and the amount of rainfall. All of this makes predicting the effect of carryover N on next year's corn yield essentially impossible to predict.

There are a couple of potential management changes that might be made after a drought year. As you read this, the first possibility is either too late or already done. That is to plant a fall grass cover crop to capture some of any excess N in the soil. While this would tie up the N for a little while until the grass decomposes, at least the N is not lost forever. Another option is to plan on sidedressing N next season and to take a Pre-Sidedress Nitrogen Test (PSNT) prior to sidedressing. If there is appreciable N carryover, it should show up in the PSNT test. For more information on taking and using a PSNT sample, visit the library on our website at spectrumanalytic.com. The best approach for most Corn Belt growers is likely to be planning next year's N rate based on yield goals and past experience in a "normal" year. If you are lucky and have some N carryover, it will probably just contribute to higher than expected yields. That would not be such a bad outcome for most growers.

It's All About Leaves and Roots

By Emerson Nafziger. Originally published in The Bulletin, U of IL, No. 12 Article 11/June 16 2006.

The corn and soybean crops are mostly planted and mostly up in Illinois, even where replanting was needed due to poor conditions. It's been a good planting season for corn in most of Illinois and a less favorable one for soybean, with cool, damp weather in mid-May and conditions ranging from too dry to too wet. Soybean replanting percentages were much higher than normal in some areas. About the only positive part of this is that replanted soybeans have ended up not too far behind fields that were not replanted, as the latter struggled with the weather and soil conditions.

Most areas have received rainfall in the past week, and growing degree-day (GDD) accumulations since May 1 are fairly close to long-term averages. Corn that was planted in early April received 150 to 250 GDDs before May 1, and as a result it is ahead of normal in its development. In central and southern Illinois, early-planted corn is at V10 to V12 and ranges from waist high to chest high. Stands are very good in most cornfields.

Soybean is coming along after the late start, with the fields planted in early May now at about V3, which means three fully expanded trifoliate leaves (those with three leaflets, as opposed to the bottom leaves on the stem, which have only a single leaflet). There is some debate about how to tell when a leaflet is fully expanded, but for practical purposes we can take it as the point when the leaf is at least as large as the leaf below it. That works for the first half of the season, when mature leaf size tends to increase as you move up the stem. After flowering, new leaves often do not get as large as older leaves, with the largest area per leaf found on leaves attached at about the midpoint of the stem.

Over the next month, the corn canopy will complete its growth in all but the latest-planted fields. Canopy formation is a critical process in crops, in that it sets the stage for successful flowering and grain filling. In corn, we often note when the canopy closes, which is the point when it appears that nearly all of the sunlight is falling on leaves rather than some getting through to the soil. With 30-inch rows, the canopy appears to close when the crop is about 30 to 36 inches tall, especially when there has been enough moisture that leaves are as wide and as long as usual. Moisture stress then makes leaves curl; hybrids with more upright leaf growth (though this is usually not nearly as apparent on the lower leaves as on the upper leaves) and wide rows make the canopy look less closed, and make canopy closure appear to happen later.

Is canopy closure as important as we think it is? It is clearly an advantage for the crop to be taking in as much sunlight as possible as early in the season as possible; so, yes, rapid development of leaf area is important. The longest day of the year is at the summer solstice, which occurs next Wednesday, June 21. On that day (if it's not cloudy), the crop receives more sunlight energy than on any other day, and this does the crop good only to the extent that it has leaf area to intercept the light. If we had a way to manage it, having grain fill taking place in late June would be even better than having only leaves and stalks and roots growing, but at least the "factory" needed to produce a lot of kernels and to fill them later is being formed, and larger, heavier plants at the time of pollination tend to produce higher yields.

While our informal method of assessing leaf area is to assume the canopy is complete once the row middles seem to be covered by leaf area, walking out into the crop tells a different story. When we do that, we will find a considerable amount of light hitting the soil surface instead of leaves, even two or three weeks after the canopy appeared to close. Leaf area is not completely formed until about the time of silking, or when the crop reaches its maximum height. Thus narrow rows, which seem to close their canopy earlier than wider rows, might be taking in only a little more sunlight in mid-June than are wider rows. If a streak of sunlight is still visible around noon by the time the crop pollinates, though, this is a good indication that the rows are probably too wide to produce maximum yield. This is also affected by hybrid, especially plant size, and by growing conditions in June. Periods of dry weather reduce stem growth and final height, and they can also reduce the size of individual leaves, leaving the canopy less complete.

The formal way that we measure leaf area is by taking leaves off the plant and running them through an area meter, or by using a device that measures leaves while they are still on the plant. Because we are interested more in the leaf area of the whole plant community than in the area of individual plants, we usually convert the leaf area into a leaf area index (LAI), which is the leaf area per plant divided by the amount of ground area that each plant occupies. So, if we measure 6 square feet of leaf area from a plant and the plant occupies 1.5 square feet of land area (that would mean a plant population of about 29,000 plants per acre), then the LAI

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Lessons From Plant Analysis In 2012

By Bill Urbanowicz

We analyzed thousands of plant tissue samples this year until the drought set in when we saw crop growth slow and plant samples also stopped because of irregular crop growth in much of the Midwest. The survey listed here tells quite a story about the nutrient situation of our crops. In looking at the data, keep in mind that this is a biased survey. That's because most people don't send us samples of healthy appearing or acting plants. They more often are trying to find out why the crop is not performing as they would like or expect. Having said that, this year more customers than ever took our advice and sampled crops that they thought were "normal". As the following table shows, there were a lot of hungry crops in 2012.

We have highlighted the values that indicate more than 33% of that crops nutrients were low, but that is an arbitrary choice. No crop producer would want a third of his crop to nutrient deficient, so take notice of some of the other results as well as the highlighted ones.

Many of these samples had accompanying soil test results, the fertilizer program, and recent weather conditions. From this information it was apparent that the main reasons for these results were…

Acid Soils
Weak Soil Tests
Weak Fertilizer Programs
Annually Cash-Rented Land (probably)

Some of the K deficiency that is being seen is due to the drought conditions that many areas were under this year. The use of calcitic lime may be a reason for the amazing number of low Mg levels. However, a lot of growers have to pay a little more for dolomitic lime and they apparently are not willing to use this inexpensive source of Mg. Of course this is a "pay me now, or pay me later" situation and they paid later with an Mg deficient crop. Another reason for a few of the low Mg levels is that some growers have gotten their soil K:Mg ratios out of balance. Grasses (especially corn) like a soil K:Mg ratio of about 1:1. If the soil K:Mg ratio is higher than about 1.5:1 (in ppm or lb/a, not saturation), nearly all crops will have Mg problems... again, regardless of how high the soil Mg level is. This is because the excess K will prevent adequate uptake of Mg.

After emphasizing the problems of excess soil K, we see that low plant K uptake is probably the second most widespread problem. For a long time now, we have watched as the K fertility of farmland in general has deteriorated. This was happening before the price of potash spiked, but based on our experiences, that spike in prices appears to have further weakened potash use and aggravated the slide in soil K tests. As with lime, we suspect that annually cash-rented land is one of the main reasons for weak fertility programs in general.

While it understandable that a grower might resist the idea of risking a medium to long-term investment in land that he might not be farming next year, poor fertility will cost him this year. The 2010 IPNI Soil Test Levels in North America reported 63% of samples from Kentucky below the critical level, Ohio at 36%, Michigan 62%, Indiana 28%, Pennsylvania 25% , and New York 22%. Poor K programs seem to be most pronounced in Midwest corn-soybean rotations. Growers have

2012 Plant Analysis Survey
Percent of Samples Below Normal

Crop	N	P	K	Ca	Mg	S	B	Cu	Fe	Mn	Zn
Corn	24	10	16	2	25	8	1	5	1	5	5
Soybeans	32	5	**34**	4	5	1	0	11	0.0	2	0
Wheat	**51**	14	12	0	**49**	14	0	**46**	0.0	7	31
Alfalfa	19	6	**37**	0	**46**	4	4	0	0.0	7	2
Apples*	7	1	**36**	**51**	6	0	1	**57**	0.0	0	**40**
Grapes	28	16	28	33	14	12	7	10	10	0	2
Blueberry	19	3	4	0	33	3	1	**79**	6	0	**35**

Bold Values Are More Than 33% Below Normal
*Apple Ca uptake is not necessarily related to soil Ca

long under-fertilized this rotation in the apparent belief that somehow soybeans are better than they really are at "scrounging" for nutrients in the soil. In recent years we have seen increasing numbers of soybean plant samples with K deficiencies. Potassium shortages are most pronounced in dry years, because dry weather severely limits K uptake. This is an ironic twist, because K is probably the primary nutrient in boosting the ability of all crops to best get through a drought. The result is that in a dry year, a poor K soil puts crop yields on an ever-increasing downward spiral. Notice in the survey that 32% of the soybean samples were low in N. In the vast majority of these cases, the fields had been in a corn-soybean rotation and lack of nodulation was not the problem. While some of the samples suffered from acid soil, many or most of them suffered from low K. This situation is entirely understandable when we realize that the only "reason" that nodules form on soybeans is to get some free sugar from the plants. A soybean that is low in K produces less sugar, which means that the rhizobia in the nodules go hungry and produce less N. Thus we get N deficient soybeans.

Notice also that the table shows us that a lot of wheat fields suffered from low Cu, and marginal Zn. Small grains in general tend not to get the micronutrient attention that they should. Like K application, this has also seems to be an increasing trend in recent years. In our conversations with customers that have applied the needed micronutrients to wheat and other small grains, they report very large yield responses.

Space doesn't permit an in-depth discussion of all of the crops and their nutrient trends, but this information should put everyone on notice that there are significant areas for improved yields through proper fertilizer use.

It's All About Leaves and Roots

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is 6/1.5 = 4. An LAI of 4 is a good, healthy number for corn and usually indicates a crop that can intercept at least 97% of the sunlight that falls on the crop. Of course, the leaf area has to be healthy leaves with disease or inadequate nutrients may still intercept light well, but they cannot use the light as well as healthy, dark green leaves can.

Roots are also viewed as critical to the success of vegetative development, and rightly so. As we found out during the very dry June in 2005, a good root system is capable of maintaining a good supply of water to the plant almost completely from the water stored in the soil. Unlike the canopy, though, root system size and health are very difficult to evaluate. Short of digging up root systems, the only way to assess their effectiveness is to note how the aboveground part of the plant responds to periods of low rainfall. Much more stress has been noted during dry June weather in some years, very little in others. The only reasonable way to explain this is as differences in the size and depth of the root system.

We think that dry June weather is often very helpful in helping roots reach their maximum effectiveness. This is both because fewer diseases develop when surface soils are dry and because dry surface soils mean less root growth near the surface but increased root growth deeper in the soil where there is more water available. Roots cannot grow into dry soil, but as long as the leaves of the plant are healthy and supplied with enough water, the supply of energy to the roots will continue. This energy (sugars, mostly) will be diverted to those roots where there is enough water to enable them to grow and to take up nutrients. Dry weather also means more sunshine, which helps crops grow.

Is it the case, then, that the bigger the root system the better? No. Roots have an optimum size, where the benefit they provide to the plant is matched by the cost to the plant of growing and maintaining the root system. Seldom if ever is this optimum actually reached, but ideally there should be enough photosynthesis during vegetative growth to result in rapid growth of both roots and aboveground plant parts, with roots ending up larger than normal but still in a favorable proportion to the tops. Wet June weather will often favor top growth over root growth, since roots do not grow well into very wet soils. Dry June weather results in a better balance, unless it's so dry that top growth is reduced, in which case roots will start to suffer as well.

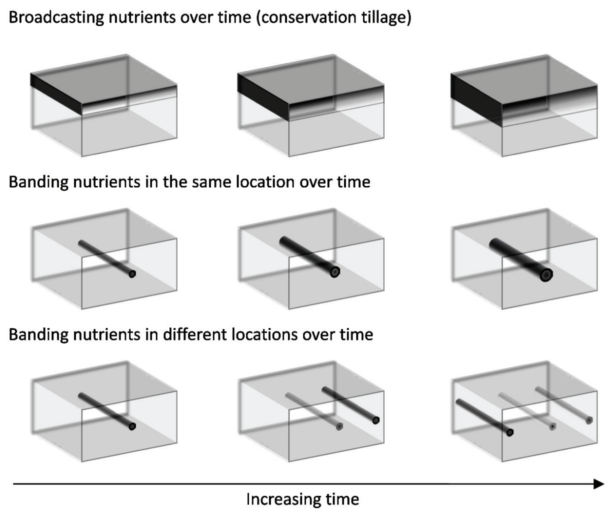
Healthy root systems do a great deal to reduce stress during pollination, which in turn goes a long way in setting the course for high yields. So far in 2006, the corn crop is doing quite well on both ends (tops and roots), and we hope this balance can continue. As water movement through plants continues to build along with the canopy, though, demands on soil water will start to deplete that supply, and we will need some rainfall to make up the difference. Few areas in Illinois are critical yet, but water loss rates are approaching an inch per week now, and most soils will need some help from rain within the next three weeks if maximum crop growth rates are to be maintained.

Soil testing and Band Fertilizer Applications

By Bill Urbanowicz

Soil testing and fertilizer applications go hand in hand by working together. Every 3-4 years someone goes to the field and pulls soil cores for lab analysis and from this the grower, dealer and consultant make a recommendation for the amount of fertilizer that they feel needs to be applied to supply the crop with the necessary nutrients for crop growth and to build the soil test level to the optimum range for production. In the past fertilizer has been broadcast, applied in bands as a starter fertilizer and in some cases may have been band or strip applied to the soil surface. Also in the past growers may work their field with a moldboard plow, chisel plow, disc or some other type of implement that would mix the soil with the fertilizer. How much actual mixing of the fertilizer with the soil would depend on the tillage tool and how aggressively it mixed the soil?

In recent years some growers have been going to deep banding fertilizer. The spacing of the injection points may vary with the type of application equipment, but for the most part the spacing has been approximately every 30 inches and the depth of injection may vary with the grower or the advice of the consultant. One thing to keep in mind is that phosphorous and potassium fertilizers will not readily move through the soil profile. As mentioned in the previous paragraph, in the past we have relied on tillage to do this mixing and moving for us. The picture below captures what effect different soil applications methods have on the concentration of the fertilizer materials.



Courtesy IPNI

The picture depicts the movement of fertilizer that is applied to the soil with time increasing as you move from left to right. In the top picture with the broadcast fertilizer in conservation tillage, you see the fertilizer moves deeper into the soil profile with time. This is almost a blanket effect where all the fertilizer slowly moves deeper into the soil in a pretty much even rate. In the middle picture you see the fertilizer in band applied in the same location over time. What we see here is that the band continues to grow a little larger every year due to the saturation of the fertilizer in the band. In effect we basically see the band growing larger in diameter as time increases. In the bottom picture, through the use of RTK guidance the band is moved over a small amount each year of application. Over time the bands will eventually begin to overlap among themselves.

As you look at the picture, the conventional procedure for taking soil samples will continue to work and give you a reliable estimate of the amount of nutrients that may be available to the plants. However, what would happen if you used conventional sampling procedures in the second and third row of pictures. Just one probe into an old fertilizer band can drastically affect your results. Hitting old fertilizer bands will greatly increase the soil test level much higher than the surrounding unfertilized soil, leaving you open to the possibility of under fertilizing in the next cropping years.

Work done in 1990 by Kitchen et al. states "If the fertilizer band locations are known, and the P band is narrow – as occurs in a V-trench associated with single or double coulters as openers – a ratio of 1:20 in-band cores to between band cores should be used for bands spaced 30 inches apart. If the location of the bands is unknown, a paired sampling approach can be effective: one sample consisting of cores taken at random, and the second consisting of cores each taken at a distance of half the band spacing from each of the first cores, perpendicular to the direction of the bands. Since the greatest deviation from the 'true' soil test P level occurs when the band locations is over sampled, the sample with the

Solvita® for Soil CO_2 Respiration reveals Microbial Biomass and Potential N-Mineralization

Adapted from http://solvita.com/soil-information

The release of carbon dioxide from soil by microorganisms reveals inherent biological energy and nutrient potential. Solvita is an innovation that bridges the gap, making it possible to economically report this trait to soil lab customers.

The quantity of carbon present in agricultural soils varies widely but levels of 10,000 to 40,000 lbs/acre of carbon are ordinary. This can turn over biologically at a rate of 1-3% per year, meaning the release of 100 to 1,200 lbs of carbon dioxide carbon. At steady state, this would potentially set free from 10 to 120 lbs/acre of nitrogen which, under conditions of cultivation, would be fully available for plant growth. Ignoring this contribution is analogous to failing to notice interest accumulating from stored capital, and actually discarding it.

This large range of potential carbon and nitrogen release from soils reveals the significance of making actual measurements of soil respiration. The recurring cycle of respiration is increasingly recognized to be tied to the productivity and sustainability of agricultural soils.

The Solvita test is applied to measure common background respiration, called "basal respiration", and potential mineralization, known as "CO_2-Burst". The latter test is based on a protocol of drying and re-wetting soil samples. This rehydration process mimics natural soil events and which many are recognizing to be a form of "biological pump" delivering soluble carbon to microbes and nutrients to growing plants. By accurately measuring the magnitude of the CO_2 pulse, the Solvita test infers microbial biomass and nutrient delivery potential. By factoring this information into nutrient budgets, it is possible to both reduce chemical inputs and to improve yield sustainability – hence improve net economic yield.

The Solvita test is furnished with an interpretation guide that enables conversion of readings to useful units and provides insight into soil carbon management. With the newly developed digital colorimeter (DCR) it is possible to directly read ppm CO_2-C a quantify which has been successfully correlated with potential N+P release.

The patented gel-technology system indicates CO_2-respiration over the range of 5 to 150 ppm CO_2-C (about 9 to 100 lbs CO_2-C / acre / day). With the Solvita DCR (Digital Color Reader), soil test values can be as precisely determined as conventional laboratory CO2-base trap titrimetry or IRGA, without the cost and fussy chemistry of these techniques.

Spectrum Analytic has been running the Solvita test for a year. Keep in mind that this test needs 24 hours for completion, so you will not receive the Solvita results as quickly as you are used to with conventional soil samples. Result number will be in ppm, you will receive additional information based on Solvita work that will give you an approximate amount of nitrogen that may be released during the growing season. It will be up to the grower to make decisions on additional N needs that may be required to satisfy the crop needs for the growing season.

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lower soil test P level is most likely to be representative."

Research reported by Fernandez and Schaefer (2012), "If the banded zone is wider, as in strip tillage, the ratio should be the same as the strip width to the non-strip width. In strip-till corn-soybean rotation with P applied in the strips 6 inches deep in the fall, a 1:3 ratio of in row to between row samples seemed adequate to estimate soil fertility levels where the location of the fertilizer band or planting row is maintained constant."

Using the above guidelines you should be able to determine what sampling method to use if band placed fertilizer is used in your area. Keep in mind, the greatest inaccuracy in soil testing is in the taking of the sample.

The Analysis is published as a service to agricultural dealers and crop consultants by Spectrum Analytic Inc.

If you have any questions or comments, please call 800-321-1562 or 740-335-1562 or Fax us at 740-335-1104.

Bill Urbanowicz
Editor

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Spectrum Analytic Inc.
1087 Jamison Road NW
Washington Court House, OH 43160

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