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VIRGINIA STATE UNIVERSITY

Tidewater Agricultural Research & Extension Center
College of Agriculture and Life Sciences
6321 Holland Road, Suffolk, Virginia 23437

(757) 657-6450 ext. 412
Fax: (757) 657-9333
www.vaes.vt.edu/tidewater/soybean

Virginia Soybean Update

Volume 10, No. 5 **July 2007**

Dear Reader,

Drought is bearing down hard on Virginia this year. Fortunate for many, rains did come in the form of thunderstorms during the last of June. For others, it remains dry, very dry in some locations. Corn is in a greater need of water at this time. But the critical reproduction stages for soybean are right around the corner. By that time, the crop will be using between 0.25 and 0.3 inches per day. We will continue to pray for rain and try to focus on those factors we can control.

The dry weather is causing changes in this year's crop. Nutrient deficiencies are appearing (see the article on page 1) and soybean rust is not doing very well in drought-stricken Georgia and Alabama. I'm including a soybean aphid and rust update in this issue. We will regularly keep you informed of developments in this front.

Also included in the issue are the results of our sprayer traffic research. Make sure you take into account yield losses from running over rows when you make decisions concerning August and September pesticide applications.

Extension Soybean Specialist

In This Issue

Dry Weather Revealing Manganese Deficiencies

It seems like we are seeing more yellow soybean fields this year. The most common culprit is manganese (Mn) deficiency, which is easily recognized by yellowing between the veins. It is a common occurrence in our Coastal Plain soils, especially those where the pH is a little on the high side (>6.5).

Manganese deficiencies are nothing new in Virginia. Most of us recognize the symptoms and are ready to spray if needed. What was different this year were some unusual ways the deficiency expressed itself. And this warrants a discussion on the unique nature of how Mn behaves in the soil.

So, what was unusual this year? First, I saw symptoms a little earlier than I expected. The symptoms arose on small seedling soybean in the 2- to 4-leaf stages. Second was the rapid onset of the symptoms; they seemed to go from green to yellow overnight. Many of these fields were in areas that received significant rainfall during that first week of June. Of course this was on the heels of drought conditions that most of Virginia's cropland was experiencing. Finally, and new for me, was that I saw deficiency symptoms in nearly equally-spaced streaks up and down one particular field. In other words, there were yellow soybeans bordered on each side by green soybeans. Upon further examination of the soil, the green soybeans were growing in firm soil and the yellow soybeans were growing in loose soil. The entire field had been conventionally tilled. The grower confirmed that the firm soils were tire tracks from the carrying wheels of his drill. Tissue and soil samples were taken from the green and yellow areas. Neither the soil nor the tissue samples revealed any differences between the two areas. The soil pH was 6.7, The tissue samples did reveal that both were deficient in Mn (18 and 19 ppm); all other nutrients were sufficient. But, why is one green and one yellow?

I consulted Dr. Mark Alley of Virginia Tech. Here is his explanation: "Mn becomes more available under "reducing" conditions. 'Reducing' conditions occur when we have less oxygen. So when the firmer area received rain, 'reducing' conditions caused the Mn oxides to be reduced to Mn^{2+} which is the form of plant uptake. In the soil that was more lose (more pore space), even with the rain, the soil stayed in a more oxygenated condition and the Mn stayed in the oxide form which is less available. However, the point is that this field is definitely marginal with regard to Mn supply if such small differences result in this situation."

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So, to put things simply, Mn oxides are not in a form available to the plant. The dry weather we experienced provided an environment Mn oxides to form. Less Mn oxides existed in the firm soils because they have less poor space, therefore less oxygen.

Keep in mind that the green plants were also deficient; they just were not showing it. Given time, they may have turned yellow as well. Or, if the soil would not have been so dry (more Mn^{+2}, less Mn oxides), the field might have just remained green. In this example, the tissue test levels were borderline; less than 20 ppm is deficient.

Although not a common occurrence, green wheel tracks have been observed by many throughout the U.S. In Ontario, Mn deficiency chlorosis in wheat was shown to correlate with tire tracks and compacted soils (Reid, 2005). As in our case, the firming of the soil by the tires created conditions where just enough Mn was released to keep the crop from showing the deficiency. In Minnesota, iron (Fe) deficiency chlorosis was related to wheel tracks associated with the last pass with a field cultivator (Rehm, 2005). In this case the only difference in the soil was greater penetrometer readings at 8 to 21 inches below the surface. Greater penetrometer readings indicate higher bulk density or compaction.

Don't read too much into this. The main reason that we see Mn deficiencies in soybeans planted on Coastal Plain soils is related to high soil pH. A sandy, high pH soybean field may require a foliar application of Mn, regardless of whether the surface is firm or loose. However, this example does show how dry weather and soil bulk density will affect nutrient uptake.

To correct a Mn deficiency, apply ¾ lb of chelated Mn (elemental basis) or 1.0 lb of inorganic Mn (elemental basis) per acre. Lower rates may not correct a deficiency and another application will be required. Make the application before flowering. The label of many Mn products calls for lower rates than our recommendations. However, the label usually states that these are maintenance rates. Once a deficiency occurs, these lower rates will not correct the deficiency and the rates stated above will be needed.

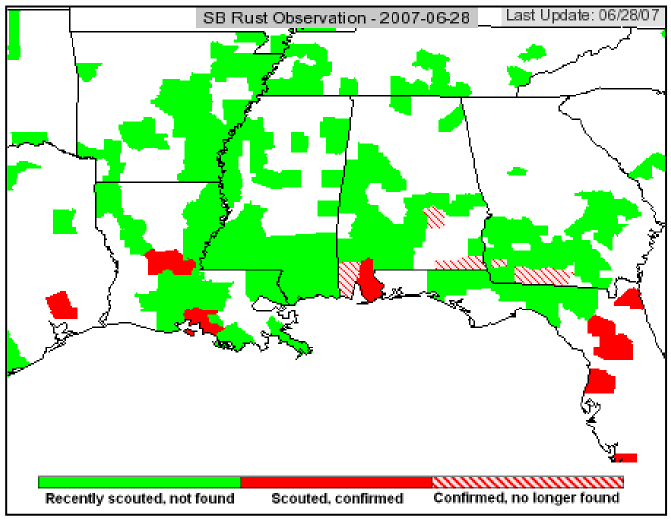
Note that most formulations of Mn will reduce weed control with glyphosate. Only the EDTA formulation does not antagonize. Therefore, it is recommended to make separate spray applications or use an EDTA formulation if mixing Mn with glyphosate.

Soybean Aphid and Rust Update

Along with the rest of the country, we continue to track both soybean aphid and rust. With funding appropriated by the Virginia General Assembly and Virginia Tech's College of Agriculture and Life Sciences, we will again be able to scout commercial fields in addition to 10 sentinel plots. Sentinel plots are funded throughout the U.S by the U.S.D.A. and are established at strategic locations to track rust movement. The General Assembly funding coupled with soybean checkoff dollars allow us to continue fungicide, disease modeling, and cultural practice research. Such research will allow us to better manage soybean rust and other diseases in Virginia.

What's the news? One pest is moving very slowly; the other is in high gear.

First, the most dreaded – soybean rust. Early in the year, it looked as if soybean rust was getting a head start over last year. But, late frosts and dry conditions changed that. To summarize, soybean rust did not do very well during drought in Alabama, Georgia, and parts of Florida. Furthermore, much of the kudzu that rust was living on was burned back with the cold weather. Only until recently, with rainfall and more humid conditions, did the disease wake up in the Southeast (see the map below).



On the other hand, conditions in Louisiana and Texas have been quite favorable. Rust is most active in those areas. Considering the current situation, it is possible that soybean rust could advance up the Mississippi River before it starts up the east coast. But, only time and weather conditions will tell.

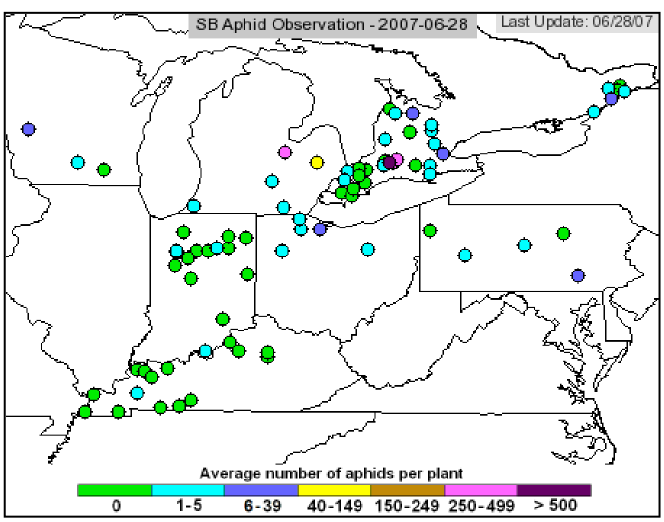
Here is a summary of the current rust situation, as of June 28, taken directly from the USDA Pest Information platform for Extension and Education (PIPE) (http://www.sbrusa.net/):

> Soybean rust was confirmed on soybean leaves from a soybean sentinel plot in Baldwin County Alabama on June 27. This is the first report of soybean rust on soybeans in Alabama in 2007. Soybean rust was reported in three new locations June 21. One was in Cameron County, Texas in a commercial field. The other two were in Louisiana in soybean sentinel plots located in Avoyelles and Rapides Parishes. These parishes are in the central portion of the state approximately 80 miles north of the positive kudzu sites in the coastal parishes of Iberia and St. Mary. On June 14th, a commercial soybean field in Hidalgo County, Texas was confirmed to have soybean rust. This county had rust earlier

in the year. Scouting for soybean rust has intensified and soybean sentinel plots are now being monitored throughout all soybean growing areas. Moisture conditions vary, but rains have been somewhat regular in areas with rust and rains have continued in most non-rust soybean producing areas. Soybean rust has been detected in 10 counties in Florida, five counties in each of Georgia and Alabama, and four Parishes in Louisiana and three counties Texas.

Soybean rust is still 400 miles away from Virginia. We have begun sampling sentinel plots and once the disease moves closer to Virginia, we also sample grower fields. The U.S. tracking system works very well, so we'll let you know when the disease gets close enough to worry about. We learned last year that our Virginia monitoring program can and will detect the pathogen as very low levels. So, we feel confident that rust will not slip into Virginia unnoticed. And, we'll let you know if and when to treat. We will keep our county agents updated regularly, so they should provide you with all necessary information. The Virginia Asian Soybean Rust website (http://www.ppws.vt.edu/ipm/soybeanrust/index.htm) provides you with our current recommendations, forecast and tracking, up-to-date fungicide registrations, and the opportunity to subscribe to our email alert system. We will also have the Virginia Soybean Aphid and Rust phone hotline (757-657-6450 ext. 425) up and running by early July. Our goal is to make sure that everyone is informed and no one will need to question if and when to treat for soybean rust.

Soybean aphid is a completely different story however. As you can see from the observation map, the pest has already hit the 250 aphids/plant threshold in Michigan and Ontario. Closer to home, Pennsylvania is finding aphid at low levels.



Dr. Ames Herbert, Extension Entomologist, is again leading our efforts with soybean aphid in Virginia. As always, he continues to keep everyone informed on a weekly basis of the insect pest situation via county offices and the Virginia AG pest Advisory (www.sripmc.org/virginia).

Early July is the earliest that we have spotted the pest in Virginia. It's beginning to look as if aphids may show up early again this year. Ed Seymore (our experienced aphid/rust scout) will begin scouting the Shenandoah Valley and Northern Piedmont during the first week of July. Afterwards, Bobby Clark and Brian Jones, County Extension Agents, will take responsibility for weekly scouting in the Valley, Tom Kuhar (Virginia Tech Entomologist) will monitor the Eastern Shore, and Mr. Seymore will handle the rest of the state.

Keep in mind that we have proven economic thresholds established for soybean aphid. Also remember that every field will be different. Therefore, it is very important to scout and treat on an individual field basis. Unlike soybean rust, we do not have to treat every acre when the pest arrives.

Sprayer Traffic Damage to Narrow-Row Reproductive-Stage Soybean

Asian soybean rust is changing how we produce soybeans throughout the country. Although the disease has yet to move into the Mid-Atlantic States early enough to cause yield loss, we are generally prepared to spray fungicides if necessary. Many growers regularly treat their soybeans with fungicides at or soon after pods begin to form (the R3 stage). Some feel they are getting yield increases with these sprays. In our small-plot and on-farm research, we see significant yield increases about a third of the time. We can usually relate large yield increases to control of diseases such as frogeye leaf spot or Cercopspora blight on susceptible varieties. Sometimes yield increases can easily justify the fungicide application. Other times, it will barely cover the cost of the application.

Many growers that treat their soybean with fungicide generally assume that the yield increase will at least cover the cost of application. Then, occasionally, they will get a big yield bump. So, in the end, they are profiting from fungicide application.

But, do we realize the full cost of spraying reproductive-stage soybeans? With soybean rust, cost is not really an issue. If soybean rust moves into our area before the full-seed stage (R6), then we will need to spray. The return will be greater than the cost because of the disease's destructive nature. But, what about other diseases such as frogeye leaf spot, Cercospora blight, brown spot, anthracnose, pod and stem blight, etc.? These diseases will not cause nearly the yield loss that rust will cause. Whether to spray or not becomes more complicated. What about insect pests? This is less complicated than disease since we have thresholds established for most of our insect pests. And thresholds are based on costs and returns. But, do we know the full cost of the application?

Would you spray if the cost of spraying is higher than the return on the investment? Of course not! That is one of the main tenets of integrated pest management (IPM). Plus, it's just good economics. But, are we accounting for all the costs? Some are. Some are not. If we're just accounting for the cost of the pesticide and not the labor, machinery, and fuel it takes to make a trip over a field, then we are not accounting for all the costs. Likewise, if we account for the pesticide and application costs, but don't account for any damage to narrow-row soybean from running over pod and seed producing plants, then we are not fully accounting for the costs.

Do we know the costs of damaging narrow-row soybean during the reproductive stages? Actually, there is very little data available. Most studies in the past have focused on vegetative stage damage (i.e., from herbicide applications). A few experiments have evaluated the damage up to flowering or pod development, but no research has been conducted in the Mid-Atlantic region. Furthermore, we don't know how full-season versus double-crop planting will respond or if drilled soybeans respond differently than soybeans planted in narrow rows.

The purpose of this article is to encourage you to consider all costs associated with pesticide applications made during the reproductive stages. We will also share will you the results of research conducted in Virginia and Delaware that evaluated tire traffic damage to full-season and double-crop soybean grown in 7.5-, 15-, and 30 or 36-inch rows.

<u>Past Research.</u> There have been two major wheel traffic studies in soybean published in the scientific literature. The earlier study was conducted in Iowa (Wilken and Whigham, 1986). In that study, researchers drove a tractor through soybean planted in 14-inch rows at one of six development stages from emergence through full-pod (R4). These researchers found that yield was not reduced until traffic treatments were applied at full flower (R2). There was always yield compensation from neighboring rows, so the yield loss was not equal to the amount of loss that would have occurred if the damaged row was removed at harvest. For instance, 22% of the plot (2 of 9 harvested rows) was damaged, but yield was only reduced by 7 and 13% at R2 and R4. In another study conducted in Indiana (Piper et al., 1989), wheel traffic treatments were applied weekly beginning at emergence through flowering (R1). Four of 14 harvested 8-inch rows were damaged (29% of the plot), but maximum yield loss was only 9% when the traffic was applied at R1. Neighboring rows again compensated for the damaged ones, but not completely when applied at late vegetative or during flowering.

Keep in mind that the percent yield loss from those experiments was loss in a small plot. If extrapolated out to larger spray boom lengths, then the yield loss per acre would have been less than 2%. More recent research (unpublished) from Missouri and Indiana show similar results. Yield losses in those experiments generally range from 1 to 4%, depending on spray boom width.

<u>2005-2006 Experiments in Virginia and Delaware.</u> Full-season and double-crop experiments were conducted at Suffolk, VA and Georgetown, DE during the last two growing seasons. At each location, soybeans were planting in 7.5-, 15-, and 30- or 36-inch row spacing. Half of these plots received wheel traffic at the R4 (late pod) to early R5 (beginning seed) development stages. We chose these stages assuming that this is when soybean rust would most likely move into the Mid-Atlantic States. Four rows were damaged in the drilled plots, two were damaged in the 15-inch rows, and no rows were damaged in the 30- or 36-inch rows. This resulted in a 25% of the rows being damaged by tire traffic. In addition, one half of the plots received Quadris® fungicide treatment at the same time that the row damage occurred. The Georgetown site was irrigated; the experiments at Suffolk were rain fed. The results of these experiments are shown in Table 10.5.1.

Table 10.5.1. Calculated percent yield loss from tire traffic to two 15-inch rows or four 7.5-inch rows to small plots and if sprayer was 45 to 120 feet wide. Wheel traffic damaged 25% of the rows in all plots except the 15-inch row spacing at Georgetown, where wheel traffic damaged 29% of the rows.

Cropping System	Year	Location	Row Spacing	Plot	Sprayer Boom Width 45	60	90	120
				--------------------% Yield Loss--------------------				
Full Season	2005	Suffolk	7.5	12.6	2.8	2.1	1.4	1.1
			15	20.9	5.6	4.6	2.8	2.3
			36	---[x]	---	---	---	---
	2006	Suffolk	7.5	12.1	2.6	2.0	1.3	1.0
			15	21.2	4.8	3.5	2.4	1.8
			36	---	---	---	---	---
	2006	Georgetown	7.5	20.6	4.6	3.4	2.3	1.7
			15	16.6	3.2	2.4	1.6	1.2
			30	---	---	---	---	---
Double Crop	2005	Suffolk	7.5	29.0	6.4	4.8	3.2	2.4
			15	25.5	5.6	4.3	2.8	2.1
			36	---	---	---	---	---
	2006	Suffolk	7.5	11.5	2.6	1.9	1.3	1.0
			15	15.5	3.4	2.6	1.7	1.3
			36	---	---	---	---	---
Average (Full-Season & Double-Crop)			7.5	17.6	3.8	2.8	1.9	1.4
			15	19.9	4.5	3.5	2.3	1.7
			30/36	---	---	---	---	---

[x]Wide rows suffered no significant yield loss with wheel traffic.

A few things are worth noting. Our yield losses are generally higher than that found in the Iowa and Indiana studies. The range in yield loss was also quite large. As little as 12% reduction occurred in some treatments, while up to 29% reduction occurred at the 2005 double-crop test in Suffolk. Yield compensation from neighboring rows occurred in 4 of 5 experiments via increased number of pods (not seed size). No compensation occurred in the 2005 double-crop test. In that experiment, an 18-day period of high temperatures and no rainfall preceded the wheel traffic treatment at that location. Rainfall was not received until 4 days after the wheel traffic treatment. This 3-week period of hot and dry conditions was likely responsible for lack of compensation from neighboring rows and the higher yield loss.

We hypothesized that drilled soybean would compensate better because wheel traffic removed 25% less total area of soybean than in the 15-inch rows. For example, after wheel traffic, there was a 22.5-inch gap in drilled and a 30-inch gap in 15-inch soybean between the undamaged rows. In 3 of the 5 locations, this was the case. One of the exceptions has already been mentioned. In that experiment, no yield compensation took place regardless of row spacing due to the dry weather conditions. At the irrigated Georgetown, there was more yield loss in the drilled soybean than those planted in 15-inch rows. Why this occurred cannot be explained. For the most part, the drilled plots suffered less yield loss.

There was no clear trend with cropping system; the double-crop experiments had both the highest and lowest yield losses. Instead, these data indicated that environmental conditions are most important in the compensatory potential of soybean damaged by traffic. Yield losses were less in the 2006 double-crop experiment, where with the exception of the Georgetown experiment; there was the least amount of water stress during pod development. Yield losses in the 15-inch rows at the irrigated Georgetown location were also low. At the other extreme, under hot and dry conditions at the 2005 double-crop experiment, yield losses were highest.

No yield loss occurred from sprayer traffic in 30- and 36-inch rows. But, yields of soybean planted in wider row spacing were lower and approximately equal to narrow-row plots damaged by wheel traffic in 4 of 5 locations. When adjusted for the sprayer boom width, the yield loss from using wide rows was greater than loss due to wheel traffic in narrow rows. Therefore, there is a disadvantage of using wide rows to avoid wheel traffic damage in most cases. Only in the irrigated Georgetown site did soybean planted in the wider rows yield the same as those planted in narrower rows with no wheel traffic. At this site, an indeterminate variety was planted in 30 inch rows, a slightly narrower row width than the 36 inch rows used in Suffolk. This site is also farther north. These factors may have contributed to the differences, but lack of water stress at the Georgetown site is likely the main reason for the lack of row spacing response. Irrigated conditions provide for more leaf area. Under high rainfall or irrigated conditions, soybean planted in wide rows is more likely to meet minimum leaf area requirements.

When prorated to 45-, 60-, 90-, and 120-foot booms, yield loss averaged 3.8, 2.8, 1.9, and 1.4% for the 7.5-inch rows, and 4.5, 3.5, 2.3, and 1.7% for the 15-inch rows, respectively. The range on either side of these average losses is almost half of those amounts. For instance, yield losses varied from 1.9 to 4.6% loss using a 60-foot spray boom. Depending on yield potential and sprayer boom width, a grower could lose less than one to several bushels in yield.

Fungicide application increased yield by 3.2 and 2.3 bushels per acre in the 2006 Suffolk and Georgetown full-season tests (6.5% and 4.4%), respectively. Yields were not affected by fungicide at the other sites.

<u>To summarize these results, one may expect between 1 and 6% loss from running over soybean rows in the Mid-Atlantic region.</u> The amount of loss will depend on the sprayer boom width, row spacing, and environmental conditions. There will likely be less of a loss in drilled rows than in 15-inch rows because the resulting gap is smaller (22.5 inches versus 30 inches). Environmental conditions before and after the damage will affect the amount of compensation from neighboring rows. If we were to assume a 2% loss to traffic, the monetary loss that one would need to factor into their spray decision is shown in Table 10.5.2. As you see, the cost of running over soybean rows can be quite large, even when we assume a minimal loss by using a wide boom width. With today's soybean prices hovering around $8 per bushel, we need to definitely take this added cost into consideration. Of course, with $8 soybeans, it does become easier to justify the fungicide - if yields can be increased.

Table 10.5.2. Monetary loss from sprayer traffic damage to soybean at differing yields and prices, assuming a 2% yield loss.

	$/Bushel				
Bu/Acre	**$5.00**	**$6.00**	**$7.00**	**$8.00**	**$9.00**
20	$2.00	$2.40	$2.80	$3.20	$3.60
25	$2.50	$3.00	$3.50	$4.00	$4.50
30	$3.00	$3.60	$4.20	$4.80	$5.40
35	$3.50	$4.20	$4.90	$5.60	$6.30
40	$4.00	$4.80	$5.60	$6.40	$7.20
45	$4.50	$5.40	$6.30	$7.20	$8.10
50	$5.00	$6.00	$7.00	$8.00	$9.00

<u>Solutions to Traffic Damage.</u> There are several solutions to preventing traffic damage. The first is too late for most of this year's crops. That solution is to install tramlines for the sprayer to run. Not only will tramlines prevent the damage, it will help prevent pesticide overlap which has been estimated to be 2 to 7% in fields without a GPS guidance system. So, tramlines have extra savings. If you don't have a tram system installed on your drill and you are spraying by ground, you may want to consider installing such a system in the future.

A second solution is aerial application. Aerial application has been shown to provide adequate pesticide coverage to reproductive-stage soybeans. Plus, more acreage can be covered in less amount of time.

Another option, although not necessarily a solution, is to factor the extra costs into economic thresholds. In the least, this should be done. As stated earlier, thresholds are established for most insect pests, so this can be easily done. Disease thresholds, due to the preventative nature of fungicides, are more complicated. To utilize disease thresholds, it will be necessary to develop a predictive model based on current and future environmental conditions. We will also have to take into consideration the variety being used (i.e., whether it contains a good disease package or not). I'm not sure if we are able to do this yet. We know the cost of the fungicide. We know the cost of the application. I've given you the expected cost of running over soybean rows. But, we cannot yet consistently predict the yield benefit. For now, we will just have to use our expected (or hoped for) yield increase from using a fungicide.

In conclusion, insecticide or fungicide sprays can improve our soybean profitability. But, running over soybean while they are producing pods will increase our application costs via a yield loss. Solutions to this damage include tram lines, aerial application, and the inclusion of these costs into our economic thresholds. It is very important that you account for the increased application costs associated with reproductive-stage pest management decisions. Know your costs. Evaluate the research data. And, only make pesticide applications if they can be economically justified.

Questions & Answers:

The following are a few questions that have been addresses to me over the past couple of weeks. Usually if one asks, others would like to know the answer as well.

Q: I planted soybean in 15-inch rows on May 25, but due to the dry weather I only have half a stand. My average plant population is 50,000 plants/acre. The stand is generally poor throughout the field. This is a good yielding field, usually 40 bushels/acre. Should I replant? (Note: it is now June 11)

A: No. Although your final stand is below our recommendation, you will likely lose more yield due to the late planting. Our research shows only 10% or less yield loss with this plant population when planted in May. When you add in the additional expense of replanting, then I'd stick with the stand that you have. An alternative to doing nothing is replanting between the rows using a seeding rate of about 2 seed/foot and a variety about ½ maturity group earlier. However, research in other states has not shown this to be economical.

Q: What maturity group should I use for double-crop planting?

A: Use the latest maturity group that will reach physiological maturity before your average frost date. Physiological maturity is when most of leaves have dropped and most pods are yellow or yellowing. Generally, a mid-group 5 variety will reach physiological maturity by the middle of October if planted by the first week of July. A late group 4 will mature about a week earlier. In southern Virginia, use a group 5. In northern areas, a late group 4 may be better suited.

Q: Should I spray manganese (Mn) on my soybean with my herbicide to prevent a deficiency? What about boron (B)?

A: I generally do not recommend preventative applications of micronutrients. This is because you really don't know if you will have a deficiency or not. Too much is dependent on the soil and environment. Plus, if a Mn deficiency does occur, it can be easily rectified with a foliar application. In addition, combining most Mn formulations with glyphosate herbicide can reduce weed control. Saving a trip over the field by mixing the two may not, in the end, be much of a savings.

We have not seen a benefit to B applications in Virginia. We conducted 3 years of research on this in the late 1990's. In addition, in areas of the U.S. where B has shown to be beneficial, the applications are made during early pod development (R3). A vegetative stage application would show little benefit.

Q: How do I control glyphosate-resistant corn in my soybeans?

A: Use any of the graminicide herbicides (Assure II, Fusilade DX, Poast, Poast Plus, Select, Fusion) at the labeled rates for volunteer corn control. Note that most labels recommend you make the application before the corn reaches 18 to 24 inches. Usually a slightly lower rate is required that for most annual grasses. With some products, higher rates are needed for larger corn. So, follow the label. A crop oil concentrate for most of these products. Some require ammonium sulfate and non-ionic surfactant instead of crop oil concentrate.