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Virginia Soybean Update

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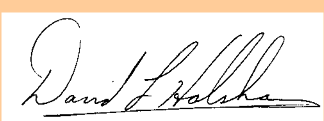
Dear Reader,

Planting season is always a season of anticipation and hope. We set our sights on high yields, minimal input costs, high prices, and maximum profits. Some may say that such expectations are not realistic. But we are a hopeful bunch. Otherwise, I'm not sure if anyone would be in or affiliated with this business of farming.

A fellow church member once observed that, in general, farmers had much greater faith than the rest of the population. He asked why? Of course, if you receive this newsletter, the answer is obvious. Farming is a business that is almost totally dependent on the weather. Sunshine and rain is probably the most uncontrollable input on the planet. And it, more than anything controls our success. I think the answer to the question posed is obvious. Faith, and hope, is required in our profession.

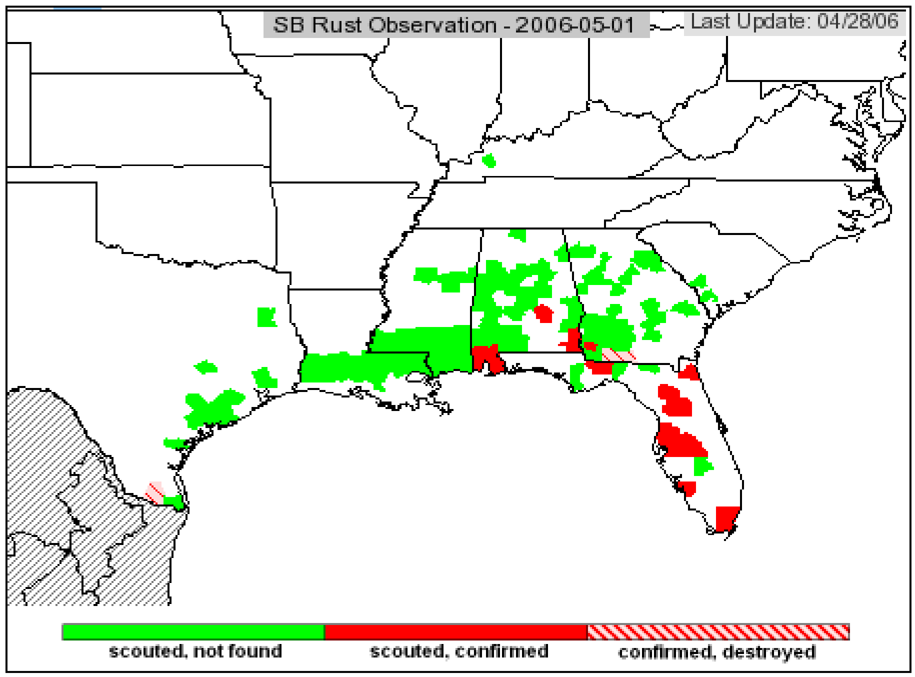
Still, there are many factors that are under our control. This month, I talk in detail about one of those – row spacing. And there are many others. So, we do our best agronomically and leave the rest up to the Lord.



Extension Soybean Specialist

In This Issue

Rust Movement Slowed by Dry Weather



The signs were not encouraging earlier this year. Kudzu remained green in protected sites, largely in urban areas. Because of our warm winter, soybean rust had overwintered much farther north that it did in 2004/05. Reports of soybean rust in Mexico and southern Texas also indicated that the disease would be worse for other parts of the country in 2006.

However, dry weather seemed to have slowed development and movement over the past couple of months. Concerns of an early epidemic have therefore been tempered. Still, recent rainfall over the past couple of weeks in the southern U.S. has created perfect conditions for soybean rust survival and movement. Wind currents from infected areas have also been coming our way. In addition, Kudzu is leafing out from Louisiana to the Carolina's. Therefore, we should begin to see some movement within the next few weeks.

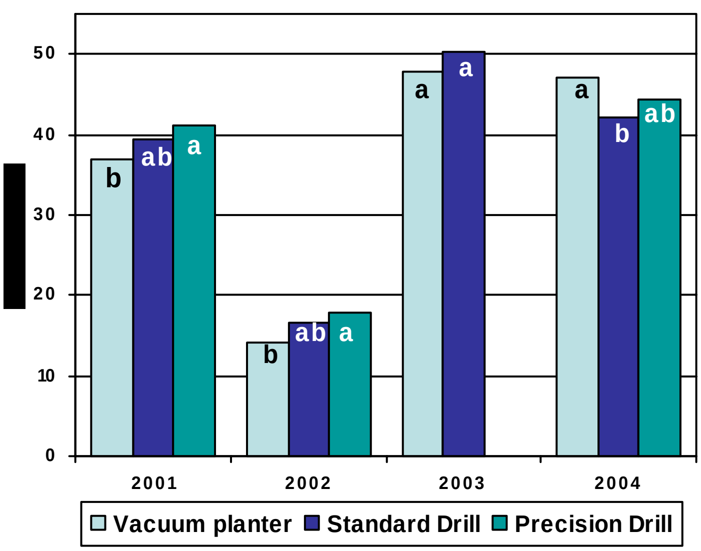
So the news is good and bad. The best news is that we are tracking any movement closely. Sentinel plots have been established in the lower south (see map above). Plots in the upper South, including Virginia, will be planted within the next couple of weeks. The USDA web site has also been updated and improved for the 2006 growing season. I'll send more information on those improvements at a later date.

In Virginia, we have plans for 10 USDA sentinel plots. From these plots, we'll collect 100 leaves weekly and bring them back of one of three labs for observation by our plant pathologists. In addition, we'll also monitor about 40 commercial fields. So, we're prepared for the worse. But, we'll hope for the best.

Row Spacing and Uniform Stands

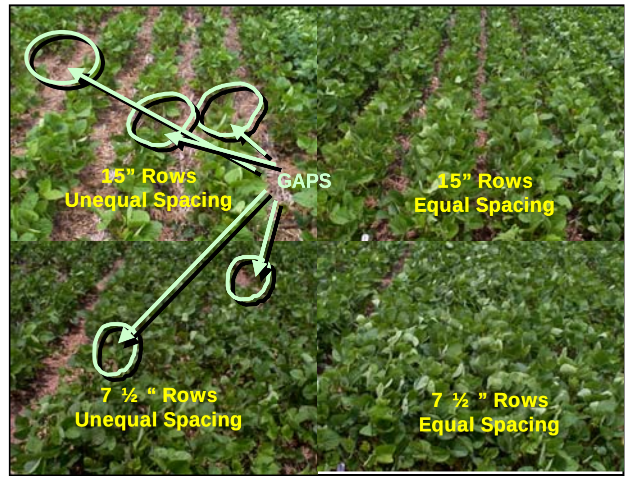
I recently published a paper on our research that compared the Great Plains GP1520P drill with a 15-inch vacuum-meter planter and a standard drill. The GP1520P is considered a “precision” drill because it uses a metering wheel to distribute seed instead of the more conventional fluted cups found in the standard drill. The metering wheel greatly improves stand uniformity within the row. Our hypothesis was that soybean planted in narrow rows (7 ½ inch) would yield higher than soybean planted in wider rows (15 inch) if spacing between plants within a row was more uniform than could be obtained with a standard drill. We conducted the research in a double-crop system in Richmond County from 2001 through 2004.

Fig. 9.3.1. Planting Equipment Effects on Soybean Yield. Yields with the same letter, within a year, are not significantly differerent.



The research confirmed that stand uniformity with the precision drill was equal to the vacuum-meter planter and better than the standard drill. Plus, soybean planted with the precision drill yielded higher than the planter in 2 of 3 years and equal to the planter in the third year. Averaged over 3 years, the precision drill yielded 10% higher than the planter, and ranged from 0 to 25% higher. The highest percent yield increase was during the drought year of 2002 (14 versus 18 bushels/acre). Interestingly, soybeans planted with the standard drill yielded the same as the planter in 3 of 4 years and lower than the planter in one of those years.

There were two important conclusions from this research. First, narrowing row spacing below 15 to 20 inches can increase double-crop soybean yield. Secondly, in order to consistently realize this increase, you must insure uniform plant spacing within a row. So, do the best possible job of distributing the seed within the row when using a drill. Avoid those gaps that are typical of a drill.



You can access the *Crop Management* article at the Plant Management Network website: http://www.plantmanagementnetwork.org/cm/. Or if you prefer, I can send you a copy.

I’d like to look into these two concepts in a little more detail in this issue of Soybean Update, especially the row spacing issue. You have probably already decided on your row spacing and will not be buying any new equipment. So, this article may not be that timely for you. Still, some have the capability to plant in a number of different row widths. Plans change and you may need to make a quick decision in order to get the crop into the ground in a timely manner. It might be to you advantage (time, labor, fuel, etc.) to use the wider row spacing.

But, how much yield will this lose you if you move to wider row spacing? I continue to get this question every year, “Is there any advantage of drills over 15 to 24-inch rows?” In a double-crop system, our data indicates that you will get a yield advantage with a drill, but only if you insure uniform stands (no gaps). What about full-season? My old answer would have been “No.” Why? It’s because my philosophy was that the major benefit of narrow rows was to insure adequate leaf area and canopy closure, which we generally have little trouble of achieving in full-season systems. But, a review of research throughout the U.S. indicates that narrowing rows to drill widths in full-season systems can also increase yield. Still, I think that this can only be achieved with uniform stands.

I even get inquiries regarding the amount of yield increase one can expect from drills versus 30- to 36-inch rows. So in the next article, we’ll review row spacing research, and when and where you should expect yield increases.

Row Spacing – Review of the Research

A plus of conducting and publishing research is that one has to perform an extensive review of relevant research in that field of study. And sometimes what we find out on that subject is not necessarily what we thought was correct. This was the case with me when I began reviewing the literature on row spacing. My overall view was that a response to row spacing was more likely and greater in a double-crop system where leaf area development is lacking. In general this is true, but I actually found that full-season responses were just as likely and in some cases, just as great.

Full-Season Yield Responses. In general, in an average or good year, research has shown that yields will increase if row spacing is narrowed from 30+ inches to 15 to 24 inches (page 4, Fig. 9.3.1). These data are from experiments conducted over the past 30 years or so. I've taken the liberty to average over planting dates (none were later than early June), maturity group, tillage system, and other miscellaneous factors included in the test when those factors did not affect the general results. Because of this research, I've always encouraged growers to narrow their row spacing 24 inches or less, even in full-season systems.

There are exceptions. For instance, a couple of years ago, we conducted an experiment on the Eastern Shore comparing row spacing of 7.5, 15, and 30 inches. The soybean grown in 7.5- and 30-inch rows yielded better that soybean grown in the 15-inch rows. I was not surprised that the 30-inch soybeans did as well as 7.5-inch row spacing since it was a high-yielding year and on a good soil. But, I still cannot reason why the 15-inch row soybeans yielded less.

Although narrowing row spacing to 15-24 inches is usually beneficial, I never encouraged (nor discouraged) anyone from going to drills in full-season soybeans. I just did not think the benefit would consistently be there. However, research seems to contradict me on this (Fig. 9.3.2). These data seem to indicate that just as large of a yield response is possible from narrowing the row spacing to drill widths. However, keep in mind that most of these experiments were conducted with research planters; therefore, the problem of stand uniformity was not an issue. I would suspect that if a full-season test was conducted similar to the one that I conducted in double-crop soybeans (see previous article), the results would be similar. You may not see a yield increase by just narrowing rows with a standard drill. But, I would suspect a yield increase similar to that shown in Fig. 9.3.2 if a precision drill was used.

Narrow row benefits did not hold up in studies experiencing late-season drought stress (Fig. 9.3.3). In those cases, yields were either the same or lower with narrow row spacing. Why? It's because narrow rows tend to remove more water from the soil profile earlier in the season. Unless that soil moisture is replenished by rainfall or irrigation, little soil water will be available for use later in the season. With less soil water available during the critical reproductive stages, yields, at best, remained the same, or at worst, declined in the narrow row spacing.

So, there is a risk to narrowing rows to drill widths. But, I contend that although this is a risk in theory, it's not a risk in practice. Why? Yields in those cases averaged 15 bushels or less. I question the profitability of growing soybeans if yield potential is that low. Yes, sometimes we experience yields that low in Virginia, but we don't and should not plan for it.

Double-crop Yield Responses. A yield response from narrowing row width in double-crop soybeans is old news. We all know there is a yield benefit going from 30+ inch rows to narrower rows (Fig. 9.3.4). I'll spend no more time here on that subject.

But, what about going from 15 to 24 inch rows to drill widths? Yes, there is a further response, much like the full-season data (Fig. 9.3.5). Note that, in all but one study, a yield substantial yield increase occurred. I again remind you that these experiments were usually conducted with plot planters or the uniformity of the stands was controlled. If uniform stands were not achieved, I would not expect as great of a yield response.

Why do narrow rows work? Notice that full-season yield improvements ranged from 0 to 45% and double-crop yield improvements ranged from 0 to 60%. Why such a wide range? Let's examine this.

Reasons for yield increases with narrow row spacing. In a recently published article in *Crop Management*, Dr. Chad Lee of the University of Kentucky reviewed much of the row spacing data in corn and soybean. He concluded that corn yields typically do not increase as row widths decrease south of 43^{o}N latitude (that's about the Dakotas-Nebraska/Wisconsin-Iowa/Michigan-Indiana state lines). He found a similar, but less consistent trend for soybeans. The reasoning behind this theory is that the crop must produce sufficient leaf area to intercept 90% of the light by flowering. For northern climates, there is less time and heat units available to maximize growth; hence less leaf area and light interception. In contrast, southern locations have longer growing season and the crop has more time for crop growth. This increases the probability of maximum radiation interception prior to flowering, making narrow rows less necessary for maximum yields in those locations. This assumes that the correct maturity group and seeding rate is used.

(Continued on page 6)

Fig. 9.3.2. Yield advantage of full-season soybean grown in 15 to 24 inche row spacing versus 30+ inch row spacing on sites of average rainfall and little stress in the U.S. and Argentinia.

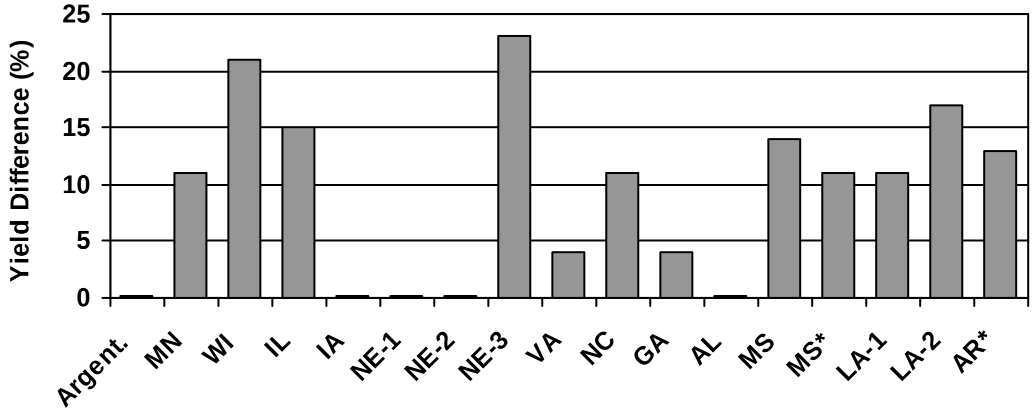


Fig. 9.3.3. Yield advantage of full-season soybean grown in 7 to 12 inch row spacing versus 15 to 24 inch row spacing and on sites of average rainfall and little stress in the U.S.

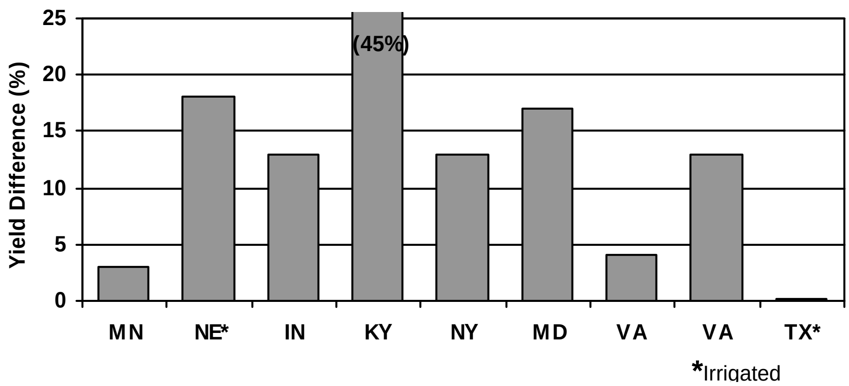


Fig. 9.3.4. Yield advantage of full-season soybean grown in 7 to 15 inch row spacing versus 30+ inch row spacing in fields experiencing either late-season drought stress and those with less stress.

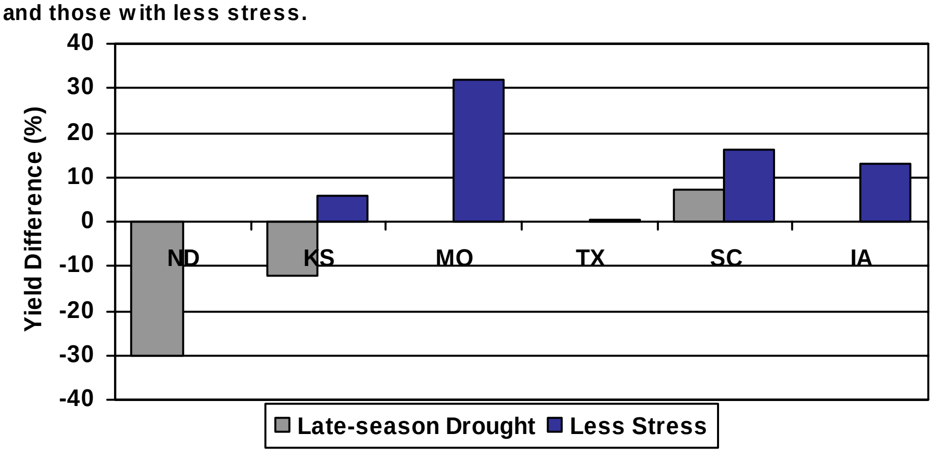


Fig. 9.3.5. Yield response of double-crop soybean grown in 7 to 20 inch row spacing versus 30+ inch row spacing at sites in the U.S.

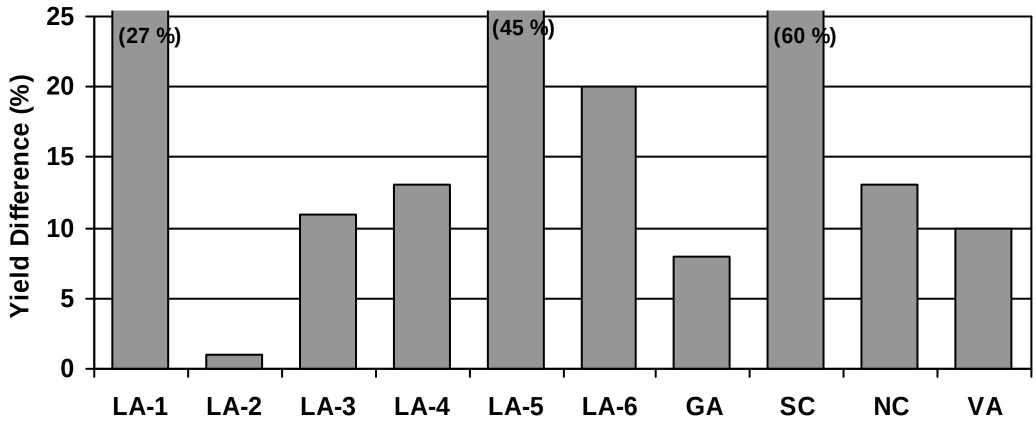
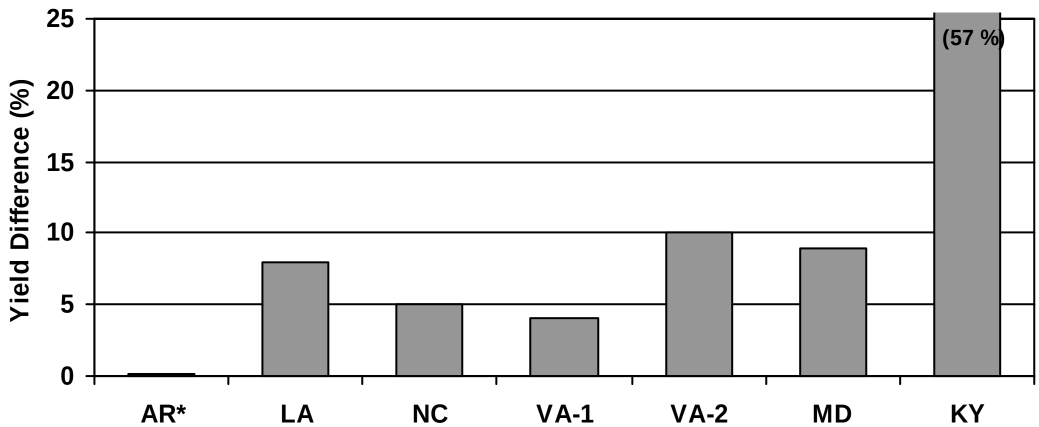


Fig. 9.3.6. Yield response of double-crop soybean grown in 7 to 12 inch row spacing versus 15 to 24 inch row spacing at sites in the U.S.



The data shown above somewhat contradict Dr. Lee's conclusions however. These data indicate that narrow rows almost always increase soybean yields. The data Dr. Lee compiled was largely from Midwestern states. So, I would agree with his conclusions that more of a yield response might be realized as one moves north, all other factors remaining constant. But, other factors vary as well.

Row Spacing and Drought. In the Midwest, soil moisture is not the problem that it is in Virginia. We are more likely to have droughty conditions throughout the growing season. So, according to Fig. 9.3.3, we in the more drought-prone areas should experience less of a response to row spacing, right? Wrong, and I'll explain why.

As I stated earlier, narrow rows will use more water than wider rows. They need this water in order to produce more growth. More growth leads to a bigger canopy, which can be translated into greater yield. But, if the crop removes most of the available water before flowering, and that water is not replenished with rainfall, then yield could be less than if wider rows were grown. This is a common situation as one moves west. August droughts are common in the Delta and Plains states. In addition, such a situation usually occurs on higher water-holding capacity soils than we have in Virginia. Even in an area that is droughty late in the season, the soil provides enough moisture to allow a big canopy. But, the soil does not hold enough moisture to carry the crop through the rest of the season.

In Virginia, we tend to have intermittent drought. In other words, drought episodes are usually relatively short (less than 3 to 4 weeks), are pretty intense due to the low water-holding capacity of most of our soils, and can occur anytime during the growing season. Last year, when it was dry from mid-August through mid-October, was an exception.

A climate with intermittent drought like Virginia's favors narrow rows. We've found that narrow rows will out-yield wider rows, especially under drought conditions. Fig. 9.3.1 shows this effect. The yield increase from narrow rows was 4.2 and 3.6 bushels in 2001 and 2002, respectively. But, as a percentage yield increase, the effect was much greater the dry year (11% vs. 25% in 2001 and 2002, respectively). In that case, much of the drought occurred early, in the vegetative stages; therefore, adequate canopy was not formed in any row spacing. But, leaf area (or light interception) was less limited in the narrow rows, so yields were greater.

So, available soil moisture (a combination of soil plant-available water-holding capacity and rainfall) will affect the crop's response to row spacing. If drought is intermittent or early in the season, then narrow row spacing will usually result in higher yields. If there is no water stress early in the year, but drought occurs during the reproductive stages, then one of two things will happen. 1) You will not see any yield increase from narrow rows; or 2) you might see a decrease in yields. But, in case 2, yields would most likely have to be unprofitably low. And, I'll say it again; we shouldn't plan for unprofitable yields.

To optimize soybean yields in a short-season production system (i.e., double-crop and/or early maturing varieties), high light interception levels (>90%) need to be established early. Late plantings or early maturity groups shorten the time until flowering; therefore there is less leaf area. Narrowing row spacing is usually more effective in increasing leaf area and light interception in late plantings and early-maturing varieties than in early plantings and late-maturing varieties. This principle of optimal leaf area follows closely with the above discussion on soil moisture. Under intermittent drought conditions, having a full crop canopy (LAI of 3.5 to 4.0) allows soybeans to effectively utilize the light energy when conditions become more favorable for seed production. This scenario occurs often in double-crop soybeans in Virginia. Regardless of soil moisture conditions, yield losses attributed to delays in canopy formation are usually minimized with narrow rows and higher plant populations.

The largest yield increases due to narrow rows are when water stress is minimized, other cultural practices optimized (i.e., variety, seeding rate, tillage, etc.), and other environmental conditions are optimal. This seems to run opposite from my discussion on drought. I stated earlier that narrow row spacing is beneficial for a crop that experiences short periods of drought. This is correct. But, research has shown that the greatest benefits of narrow rows are under very high yield potentials. The 60% yield bump in Fig. 9.3.5 occurred under very high yield conditions in a South Carolina study. Yields in those plots averaged 50 bushels, but the range was from 25 to 97 bushels per acre! In that study, Dr. Jim Frederick and his team evaluated many combinations of fall and spring deep-tillage with a minimal-disturbance subsoiler, narrow rows, and surface tillage. The highest yield was produced with fall and spring deep-tillage, no surface tillage, and 7.5-inch rows. In other words, nearly all conditions (cultural practices and weather) were optimum. Narrow rows increased yield in all cases, but the largest increases came at the highest yields.

A 50 to 70 bushel or more soybean crop requires that almost everything has to be perfect. Yield is not limited by poor growth. The plant produces a full canopy and uses nearly all the light available. There is little moisture stress, especially during the reproductive phases. And, there is no nutrient stress; all plant nutrients are adequate.

With adequate canopy formed, why do we seem to continue to observe yield increases at high yield potentials? Evidently, light interception is not the only reason that narrow rows help. It could be that narrow-row soybeans are more efficiently using soil moisture and nutrients. I cannot fully explain this and don't think this has been thoroughly researched. For some reason, there is less stress (light, water, and/or nutrients) in narrow rows at high yield potentials.

In summary, narrow rows and uniform plant spacing within a row will lead to higher yields. There are exceptions and a yield increase may not be realized every year. But, over time, narrow rows will allow the most profitable crop.