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Cooperating Departments: Agricultural Economics, Biosystems and Agricultural Engineering, Entomology, Plant and Soil Sciences, Plant Pathology
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In this Issue:

1. Removing Ruts from Fields

Lloyd Murdock, Plant and Soil Sciences

- **Large, ugly ruts are usually less compacted.**
- **Smaller ruts usually have deeper compaction.**
- **Using a penetrometer can help determine how deep compaction is.**

Fields rutted by wheel tracks during soybean harvest are a common sight in the grain producing areas of Kentucky. The ruts look bad but may not be as damaging as they look.

Even though combines can compact soil, the physical condition of the soil must be right for compaction to be severe. When soils are dry enough that they could be tilled properly, little compaction is likely to occur because shear strength of soil is great enough to withstand the pressure. This is the usual condition under which we harvest.

As the soil becomes wetter, they are easier to compact because the soil aggregates and individual particles become lubricated with water which reduces the shear strength. The large pores are filled with air and the small ones filled with water. The large pores collapse with pressure and compaction is formed. Compacted ruts are formed.

As the soils become wetter, all pores are filled with water and the soils can not be compacted but the shear strength of the soil is reduced to near zero. This causes large, deep, muddy ruts with little or no compaction.

So there are two kinds of ruts, compacted and uncompacted. Both of these can exist in the same field.

Uncompacted Ruts
These look the worst and have large raised ridges on each side of the track. There is

a lot of mud. There is no compaction in these ruts or a small amount at the bottom of the rut. The soil structure was damaged but can be easily corrected.

Correction
The rutted areas need to be smoothed for future production. No-tillage helps reestablish the soil structure. The ruts can be smoothed two ways. One is with a roller (such as a rice roller) when the soil is still saturated. The soil moves back into place and the saturated soils prevent any compaction from the process. It does negatively affect the structure but can be quickly corrected. For most people, it will require waiting until the area has dried and using surface tillage to fill and smooth the ruts.

Compacted Ruts
These ruts don't look too bad. They have little or no lip on the rut and are mostly a compressed track. In these ruts the compacted zone usually starts 1 to 2 inches below the bottom of the rut and is compacted for several inches. The depth of the compaction can range from 4 to 10 inches. Compaction can also be severe and deep on the ends of edges of the fields where grain hauling was done. These areas may need special attention.

The amount and depth of compaction can easily be checked by probing with a penetrometer, ½ to ¾ inch steel rod or long screwdriver. When pushed into the soil, the compaction can be easily felt by resistance. With this information (depth and amount of compaction), you can select the tillage tool needed for repair.

Correction
The rutted areas need to be smoothed and the compaction area broken. If the bottom of the compacted layer ends within 8 to 9 inches of the soil surface then a tillage tool such as a chisel plow could be used. For deeper compaction, a subsoiler would need to be used. If only the top 6 inches of soil was tilled to remove the compaction and the compaction below 6 inches remains, the area would produce 80 to 85% of its production potential.

If we get too anxious about this tillage in the spring, we could cause additional compaction. Compaction caused by spring tillage of wet soils can be severe and more costly than that caused by the combine at harvest. Any time soils are tilled wet, the potential for serious compaction exists. It is important that we wait for the soils to dry enough for proper tillage and shattering.

2. Record Yields – What Have We Learned?

D.B. Egli and Chad Lee, Plant and Soil Science

- **Don't get caught chasing record yields and miss the basics.**
- **There is no 'silver bullet' to raising corn and soybeans.**

The year 2006 produced another record soybean yield. A farmer in Southwest Missouri produced 139 bushels per acre to win the Missouri Soybean Association Yield Contest. What can we learn from this farmer's accomplishment that will increase the yields of all farmers? What have we learned from record yields in the past?

Farmers are no different from anyone else – they like to brag about their accomplishments. If you don't believe that, just visit a small-town coffee shop before 7:30 AM on a weekday. In fact, it is easy to imagine one of the first farmers bragging to his neighbor about his high yields 10,000 years ago when people stopped gathering their food supply from what was available and began planting and harvesting crops. The record yield syndrome in soybean is not new.

In the mid - 1960's a farmer won the Illinois soybean yield contest with 82.7 bushels

per acre. A few years later farmers in Missouri, Indiana, Nebraska and Illinois topped a national yield contest sponsored by a chemical company with yields above 100 bushels per acre. Winning yields from state contests in Iowa, Nebraska and Missouri were often in the 80 bushel range (one irrigated contest approached 100 bushels per acre) in the late 1990s according to a summary by Jim Specht (a soybean researcher at the University of Nebraska) and his co-authors in the journal *Crop Science*. They also reported that two scientists equaled or exceeded 100 bushels per acre in their research plots in the mid - 1980s. The record quoted by Lloyd Evans in his 1993 Crop Physiology book is 110 bushels per acre. The record average state yield in the US is 52.5 bushels per acre (2005 in Iowa, an average for 10 million acres) which is higher than the Kentucky record (45 bushels per acre in 2006 from 1.36 million acres).

What have we learned from these record yields? On one hand the answer is not much because we haven't found a "silver bullet" that will produce high yields on all farms in Kentucky. On the other hand, we have learned that it is the tried and true recommended management practices that provide the foundation for record yields. Close analysis of many record yields often reveals that the farmer simply followed recommended best management practices.

For example, several years of record yields in experimental plots in New Jersey (five year average of 103 bushels per acre) were attributed to high yielding, lodging resistant varieties; high quality planting seed; well drained, fertile soil (adequate levels of micro- and macro-nutrients); firm seedbed and precision planting; optimum soil moisture conditions throughout the growing season (irrigated if needed); control of weeds, diseases and insects; minimizing harvest losses; and doing everything on time.

In Kentucky we would probably add the use of cyst nematode resistant varieties and crop rotations to this list. There is certainly nothing radically new on this list, no practices that good farmers are not already using. The value of these practices is backed by years of research and experience through out the soybean belt. We know that they work and are essential, but no one would feel confident that these practices (even when rain is guaranteed with irrigation) would always produce record yields in excess of 90 to 100 bushels per acre.

Zeroing in on the cause of record yields is difficult. In fact, there is often debate about whether record yields are even real. Is it possible to produce soybean yields well in excess of 100 bushels per acre? Many Crop Physiologists and Agronomists would probably say no, but others in the soybean business would surely disagree. This debate is fueled by the failure to find clear reasons for the records. Key measurements, such as seed size (weight per seed or seeds per pound), the number of pods per unit area and key growth stages, could help determine the cause of the high yield. These measurements require extra effort and are not often made in yield contests, and, there is no guarantee that they would help pinpoint what aspect(s) of the plant, the soil or the environment triggered the record. Causes are hard to find, especially when the record occurs only in a single field surrounded by fields with normal yields.

Studying record yields and searching for the silver bullet has not, in our opinion, added very much to soybean yields in Kentucky. If producers concentrate on the silver bullet and don't pay enough attention to best management practices, yields could be reduced. It is not easy to apply best management practices to all of your production – it requires a lot of planning and paying attention to detail (and maybe a little luck with equipment and weather), leaving little room for distractions by silver bullets and records.

What have we learned from record yields? We have learned that there is no silver

bullet that you can apply in your fields next year – focusing on the best management practices gives you the best odds for high yields. The challenge is to get it done, and then the rest depends on the weather. We cannot neglect best management practices in our search for high yield; remember that "facts do not cease to exist because they are ignored" (Aldous Huxley).

3. Corn Yield Contest Winners

Chad Lee, Plant and Soil Sciences

- **Good soils, timely rains and focusing on the fundamentals equal good corn yields.**

The top three yields from non-irrigated fields in the Kentucky Corn Contest for 2006 were 274.05, 256.32 and 253.41 bushels per acre. The Schwenke Brothers of Boone County, James C. Bickett/Bickett Farms in Muhlenburg County and John Martin/Martin Farms in Todd County placed 1st, 2nd, and 3rd, respectively.

The Schwenke Brothers placed 2nd in the nation in the National Corn Growers Association Corn Contest in the "A-No Till/Strip Till Non-Irrigated" division. Seven Springs Farms in Trigg County received 2nd and 3rd place in the nation in the "A-Non-Irrigated" division with yields of 277.7896 and 272.9541 bu/acre. These two entries were received late for the Kentucky contest, preventing them from winning awards.

The Schwenke Brothers and John Martin both planted corn into 30-inch rows in no-till conditions following soybean. Seven Springs Farms planted corn in 20-inch rows in a minimum tillage situation and sprayed Headline fungicide. Older research at the University of Kentucky shows greater disease problems in 20-inch rows.

These farmers applied a range of 0.75 to 1.0 pound of nitrogen per bushel of corn. We often hear about Midwest recommendations of applying 1.2 pounds of nitrogen to get one bushel of corn. Under good growing conditions on well-drained soils, we can use less nitrogen in Kentucky.

None of these farmers used a magical potion to get high yields. Several of these farmers do not have "contest fields". These farmers were blessed with good soils and timely rains, and they paid attention to the fundamentals of growing corn. Some of those fundamentals included selecting good hybrids, planting on time, establishing a good stand, applying adequate fertilizer, providing excellent weed control, applying additional pest management where needed, and harvesting on time. In addition to all of this, each was willing to take a day or two from their harvest schedule to harvest corn for a yield contest.

4. Corn and Soybean Yield Ratios – What Should we Expect in 2007?

D.B. Egli, Plant and Soil Sciences

- **Corn/soybean yield ratio averaged 3.3 for the past 20 years.**
- **The ratio varies above and below 3.3 from year to year.**

Which crop will make the largest profit in 2007 – corn or soybean? The answer depends in large part on the relative yield of the two crops. We know corn yield is always higher than soybean, but the question is – how much higher and how much does the ratio vary?

To answer these questions I calculated the ratio of corn and soybean yield for each year from 1950 through 2005. The ratio started at about 2.0 in 1950 and it increased to about 3.1 in 1980 (Figure 1). The yields in 1950 were 37.0 bushels per acre for corn and 17.5 bushels per acre for soybean, giving a ratio of 2.1. The ratio increased because corn yield increased faster than soybean yield during this period, probably

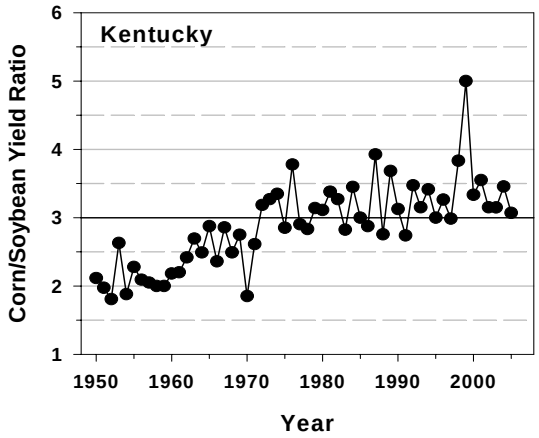

Figure 1. Ratio of corn and soybean yield in Kentucky, 1950 to 2003. The ratio was calculated using yield data (bushels per acre) from the National Agricultural Statistics website (http://www.nass.usda.gov/index.asp).

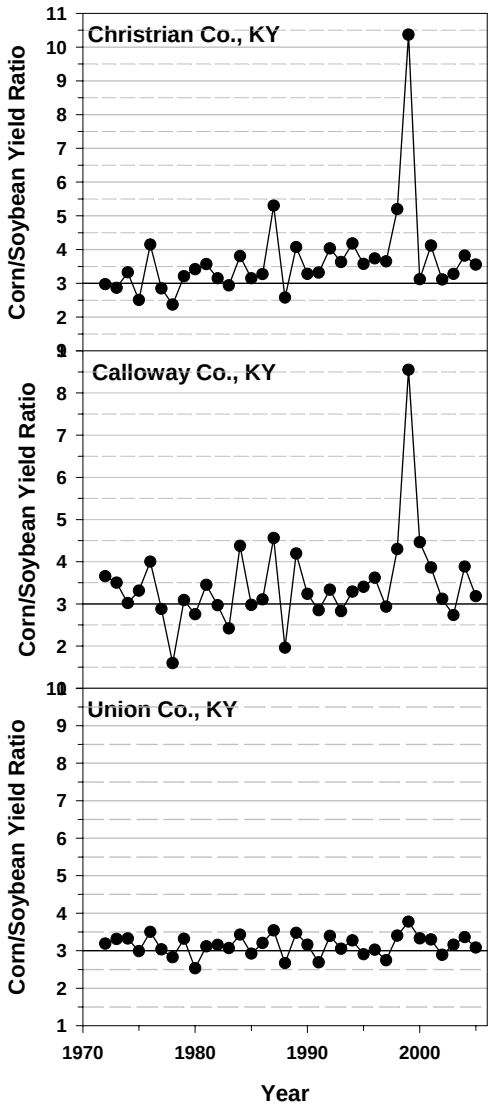

Figure 2. Ratio of corn and soybean yield in three Kentucky counties, 1972 to 2005. Yield data (bushels per acre) from the National Agricultural Statistics Service.

as a result of improved hybrids, higher N rates and plant populations, and better weed control options.

Surprisingly, there has been no trend, up or down, in the ratio since 1982; it just fluctuated around an average of 3.3. There was no trend in the ratio during this period because corn and soybean yields were increasing at the same relative rate. I also looked at corn/soybean ratios in Iowa, Illinois, Indiana, Tennessee, and Missouri and they also showed no trend for the past 20 or so years. The average ratio varied from 3.1 to 3.5. All this means that corn and soybean yields are increasing at the same relative rates in all of these states.

The ratio varied a lot from year-to-year in Kentucky (Figure 1) and in the other states. A lot of the variation may be related to which crop got timely rains during flowering, seed set and seed filling in a particular year. The highest ratio in Kentucky was 5.0 in 1999 (see Figure 1) when soybean yields were low (21.0 bushels per acre compared with 105 bushels per acre for corn). On the other hand, the lowest ratio since 1980 was 2.7; a result of a low corn yield (89 bushels per acre) and relatively high soybean yield (32.5 bushels per acre) in 1991. In the 25 years since 1980 the statewide ratio was never less than 2.7 and it was above 3.5 for only five years.

I also calculated ratios for some counties in Kentucky. The variation for Christian and Calloway counties was larger than at the state level, but the variation in Union county was

- **Only one year in the last 20, was the ratio extremely high.**

less (compare Figure 2 with Figure 1). Counties with lower yields, on the average, (Christian and Calloway counties) seemed to show more variation in the ratio than counties with higher yields (Union county).

In fact, the ratio in Union county was almost always between 2.5 and 3.5 but in Calloway and Christian counties it was often above 3.5 with some of the ratios approaching 10 in 1999, reflecting exceptionally low soybean yield. The average ratio for the last 20 years (1986 to 2005) in Union county was 3.2 vs. 3.6 for Calloway county (3.4 ignoring the unusually high ratio in 1999). The average ratio in Christian county, where soybean is commonly double-cropped behind wheat, was 3.7 (when the abnormally high ratio in 1999 was excluded), the highest ratio of any county, probably reflecting the lower soybean yields typically associated with double cropping.

What have we learned from looking at these corn/soybean yield ratios? Most years the ratio was above 3.0 at the state and county level and it was usually below 4.0, with some exceptions. The year-to-year variation in the ratio was pretty large, unfortunately, and it's not predictable. This is nothing new for farming where every crop involves a gamble with the weather. You have a choice when planning for your 2007 crop, you can gamble by assuming a high or a low ratio and hope that you guessed right. Or you can take a more traditional approach and minimize the gamble by assuming an average ratio (3.3 for example) and avoiding the extremes.

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