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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. Disease Risks when Corn follows Corn

Paul Vincelli, Plant Pathology

- **Corn on corn favors foliar diseases.**
- **Field scouting this year will identify potential problems for next year.**
- **Management includes hybrids with tolerance or resistance to diseases.**

Crop rotation is one of the most fundamental disease control practices available. Continuous corn, especially in a no tillage or conservation tillage situation, provides a continuous food source for pathogens. Several diseases can be more active under continuous corn, particularly those caused by pathogens that survive in crop residue or in the soil.

Gray Leaf Spot

This disease is a significant threat wherever corn is grown after corn. The fungus survives between growing seasons in corn residue. From there, it is spread by wind and rain to leaves of the new corn crop. Tillage practices can reduce levels of inoculum, but rotation is a key management practice. In the absence of crop rotation, susceptibility to gray leaf spot should be carefully considered when selecting a hybrid.

Management Options in Continuous Corn:

❖ Hybrids with *partial resistance* to gray leaf spot.

Diplodia Ear Rot

Although most corn fields do not experience much damage from this disease, Diplodia ear rot can occasionally cause severe epidemics, causing rot on as many as 50-75% of the ears in a field. The fungus that causes the disease only attacks corn, and it survives between seasons in residue of corn stalks, cobs, and fallen kernels. Thus, continuous corn production–especially under conservation tillage-allows the pathogen to build up to potentially destructive levels.

Scout for Diplodia. Pull back the husks of 50 to 100 plants selected at random as you walk the field before harvest. Look for white, cottony mold growth between the kernels, which usually progresses upwards from the base of the ear. Suspect samples can be confirmed through your county Extension agent.

Management Options in Continuous Corn: If more than 2 to 3% of ears have Diplodia ear rot, then management steps are necessary for the next season.

- ❖ Hybrids with tolerance to Diplodia
- ❖ Tillage

Anthracnose Stalk Rot and Top Dieback

The anthracnose fungus survives in corn residue, and causes a variety of symptoms including leaf spotting and blighting. The leaf blight phase only affects plants at the one- to four-leaf stages, but fields should be scouted later in the season for the lower stalk rot phase and "top dieback" (upper stalk rot) phase, which can affect yield and/or harvestability. There was quite a bit of anthracnose top dieback in 2006, so I suspect inoculum levels are rather high in many fields.

Management in Continuous Corn:

- ❖ Hybrids with tolerance to anthracnose

Pythium Seedling Diseases

Pythium microbes commonly present in agricultural soils can cause a variety of symptoms such as seed decay, pre-emergence damping off, and post-emergence damping off. However, Pythium can also infect root hairs and young rootlets, causing reduced vigor of developing plants. Pythium diseases can significantly reduce stand, vigor, and yield in continuous cropping situations.

Management in Continuous Corn:

- ❖ Seed treatments with that target Pythium, such as metalaxyl or mefanoxam

Leaf Blights

The fungi that cause northern leaf blight (NLB) and southern leaf blight (SLB) survive in corn residue. NLB has re-emerged in the past several years as a serious limitation to yield in fields in Kentucky where susceptible hybrids are grown. SLB generally occurs at low levels in Kentucky, because past breeding efforts have led to high levels of resistance in most of the hybrids currently available.

Management in Continuous Corn:

- ❖ Hybrids with resistance to NLB

Stalk Rots

Crop rotation has little to no direct impact on the severity of stalk rots in corn. Stalk rot incidence is influenced by high plant populations, excessive nitrogen, leaf diseases, and other factors. However, increasing continuous corn acreage could result in lengthening of the harvest season, allowing some fields of corn to stand longer before harvest. Late harvests could result in occasional increases in lodging risk and marginal increases in mycotoxin risk.

2. The Yield Penalty When Corn Follows Corn

John H. Grove, Plant and Soil Sciences

Recently, there has been publicity that the yield loss associated with growing corn after corn "goes away" in fields where management is optimized for continuous corn production. This publicity is directly contradicted by UK field research, which indicates that corn grown after corn incurs a "yield penalty" that a grower should factor into his or her economic analysis.

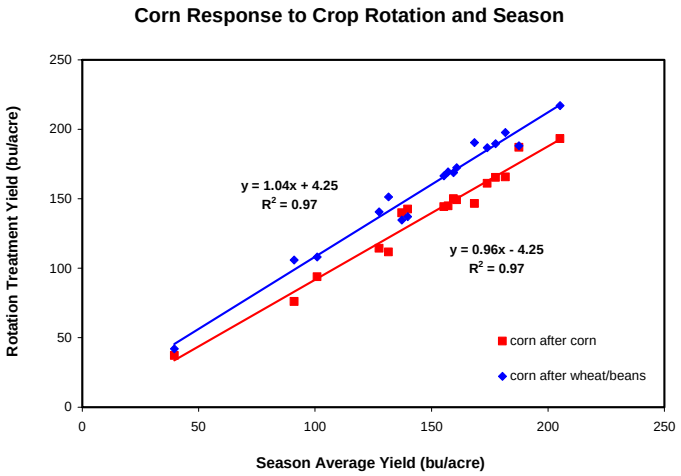
- **The yield penalty for corn on corn exists even when yields increase over time.**
- **The yield penalty for**

Yields in continuous corn fields will increase over time. However, corn yields in continuous corn fields will continue to be less than corn following soybean over time. The figure directly below summarizes 18 years (1989 to 2006 production seasons) of corn rotation research, comparing corn after corn to corn after wheat/doublecrop soybean. The study began in 1983, so these yields are well after the "initiation

period". No-till corn was planted on a Maury silt loam, and was managed optimally for soil fertility, weed and insect control, but leaving disease resistance and plant available water as potential limiting factors. Corn after corn and corn after wheat/doublecrop soybean yields were graphed against season-average yields (average of the two rotation treatments). Simple linear models were fitted to the rotation by season responses.

corn on corn is higher in high-yield environments.

The figure illustrates a striking separation in corn yields due to rotation. Corn after corn yield equaled or exceeded that of corn after wheat/doublecrop soybean in only 3 of the 18 seasons (1994, 1998, and 2003). There was no discernable pattern to these results, indicating that there was generally no improvement in corn after corn yield, relative to that of corn after wheat/doublecrop soybean, with better production seasons.



The yield increases over time in both rotations are likely due to a combination of improved genetics and management. Similar to the research study, growers are experiencing yield increases in their fields due to improved genetics and management. The yield increases over time are mistaken as a "removal the rotation effect". Based on the data from this long-term field trial, corn yields would benefit from being in rotation.

Not only does corn following corn yield less than corn following soybeans, the yield differences are even greater in more productive years. In this study, the yield from corn following soybeans increased over corn following corn by 8 bu/acre for each 100 bu/acre in yield potential, as the season-average yield increased. This results in predicted differences of 16.5, 20.5 and 24.5 bu/acre at season-average yield levels of 100, 150 and 200 bu/acre. The diverging linear models indicate that the yield benefit to rotation will rise as yields rise with improved corn genetics and crop/soil management. This suggests that, in the future, the "rotation effect" will be result in larger yield differences in the presence of better varieties, better management, and excellent corn growing conditions.

Finally, while the agronomics clearly demonstrate a yield advantage to corn following soybeans, the economics may not show an advantage, When putting the pencil to the two systems, be sure to include the proper yield differences between the two rotations.

3. Very Little More N When Corn Follows Corn

John H. Grove, Plant and Soil Sciences

- **No N credit is given to corn following soybeans in**

The high corn prices have many farmers less concerned about saving money on fertilizer nitrogen (N) rates. University of Kentucky's recommendations for N rates include factors such as soil drainage, tillage, fertilizer N timing, nitrification inhibitor use, winter annual legume cover crops and previous crop. However, UK does not give a N credit to a previous crop of soybean, wheat or grain sorghum. Land grant

universities in northern states give a substantial N credit, usually 1 lb of N per bushel of previous soybean yield, against the fertilizer N rate for corn after corn. Further, many grain growers believe that the yield loss associated with growing corn after corn can be overcome with a greater fertilizer N rate.

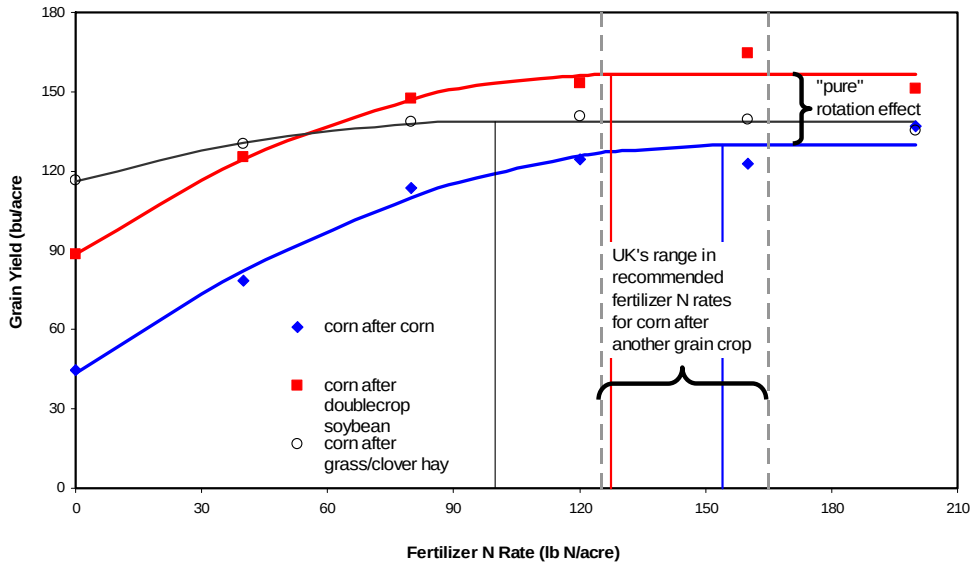
Kentucky.

- **Use the higher rate of N in the recommended rate range from AGR-1 for corn on corn.**

Corn Yield Response to N

Figure 1 illustrates corn yield response to N from UK research in 2004 and 2005. No-till corn was grown after corn, doublecrop soybean, and grass/clover hay on a Maury silt loam. Rates of fertilizer N ranged from 0 to 200 lb N/acre, using ammonium nitrate, and were applied just after planting. Prior doublecrop soybean yield averaged 44 and 50 bu/acre in 2003 and 2004, respectively.

Figure 1. Corn Yield Response to Fertilizer N and Rotation (average of 2004 and 2005 seasons)



Yields for corn after corn were less than yields for corn after wheat/doublecrop soybean, regardless of N rate used. No N rate adjustment was able to compensate for the "yield penalty" associated with continuous corn.

Nitrogen required for maximum yield was slightly higher for corn after corn (about 25 lb N/acre) than for corn after soybeans. Nitrogen requirements for both systems were within the range of UK recommendations. (Models were fitted to corn yield-fertilizer N rate relationships. The solid vertical lines indicate the N rate where each model found no further yield response. Vertical dashed lines represent the range in UK fertilizer N rates recommended) for no-till corn following another grain crop on well-drained soil.)

If an "N" credit was used, then corn after wheat/doublecrop soybeans would be under-fertilized or corn after corn would be over-fertilized.

Will Extra N Pay?

Each farmer has heard a neighbor at the coffee chop boast about applying high rates of N and getting high yields of corn. Once in a while he may actually be right. But, is he right often enough to pay for the extra N?

Corn yield responses to N were analyzed over 6 years of data to determine how often a high rate of N pays for itself. Assuming N prices of $0.35/lb of N and $4.10/bushel of corn the following conclusions were made.

When corn was grown after corn:

❖ the first 80 lb N/acre was always profitable (100% = 6 out of 6 years)

- increasing to 120 lb N /acre was profitable 67% of the time
- increasing to 160 lb N/acre was profitable 33% of the time
- increasing to 200 lb N/acre was profitable 67% of the time

Corn after wheat/doublecrop soybean:
- up to 160 lbs N/acre was profitable most of the time
- increasing to 200 lbs N/acre was rarely profitable (16% of the time)

Corn after grass/clover hay
- 80 lbs N/acre was profitable 60% of the time
- Higher N rates were profitable 20 to 40% of the time.

The complete table is available online at:
http://www.uky.edu/Ag/CornSoy/cornsoy7_2.htm

The probability of profitable return was influenced much more by the rate of N applied (probability consistently went down) than the price ratio of N to corn. At intermediate N application rates, even when the "average yield increment" would always pay for the additional N applied, there were often occasional years when that was not the case. On the other hand, the data also illustrate that there are always going to be a few years/situations where the highest rate of N is profitable. "Rare, but true" – the neighboring grower boasting at the coffee shop about one year's economic response to high fertilizer N application rates, in one cornfield, may be telling the truth.

No N Credit
No N credit is given to soybeans in Kentucky. The mild winters in Kentucky allow crop residue to decompose. As soybean residues decompose, N is lost, leaving little for an N credit next spring. Corn residues typically decompose such that very little residue is left to tie-up fertilizer N in the spring. Kentucky corn growers need to adjust their fertilizer N rate to the higher end of the recommended range when corn follows corn.

4. Can You Really Handle More Corn Acres?

Tom Miller, County Extension Agent, Ballard County
Chad Lee, Plant and Soil Sciences

With $4 corn and soybeans at $7.50, the economics indicate corn is the better choice for 2007. Assuming a corn/soybean yield ratio of 3.3, soybeans need to trade near $10 to be economically competitive with corn at $4. However, deciding to grow more corn includes more than economics... it also includes changes in logistics.

- **Economics favor corn.**
- **Logistics of more corn might favor keeping soybeans in the rotation.**

Farmers in most of the grain-producing areas of Kentucky have been fairly stable in their crop rotation pattern for the last several years. Many farmers are somewhere between 40 to 50% corn with the remaining acres being in soybeans or wheat/double crop soybeans. In counties where less wheat is grown many farmers are planting close to 50 or 60% of their acres to corn. Shifting additional acres to corn most likely require corn to follow corn. Crop rotation is one reason that Kentucky farmers have had much fewer insect, disease and weed control problems then some of our neighboring states that have a higher percentage of corn on corn.

You can successfully grow corn after corn in Kentucky but there will be a yield drag. In research published by many states the average seems to be anywhere from a 5 to 15% yield loss in corn following corn compared to corn following soybeans. There are a few more risks involved. In one season of corn following corn you probably will not see major shifts in insect populations or weed populations. You may see a big difference in disease problems even in the first year. Even with issues such as yield drag and increased disease problems, the economics of corn on corn look good.

More corn will mean more harvest, more trucks, more hauling, etc.

The biggest management challenges to raising more corn will come from planting and harvesting. Kentucky has experienced great corn yields over the past several years, due in part to the great job of timely planting. Last year (2006) all the corn was planted within 10 days to 2 weeks. Increasing corn in your rotation will lead to a more intense planting season, will lengthen the planting season and may force some corn acres to be planted at a less optimal time, or under less optimal conditions. Later planting will almost surely result in yield reductions.

While planting will be more intense, harvesting more corn provides even more challenges. Harvesting 150 bushels of corn compared to 50 bushels of soybean causes more wear on the combine, more trucks, more elevator dumps, more time in the field, more drying time, more bin capacity, etc. More corn will lengthen the harvest window for corn, possibly allowing more losses to occur from stalk problems and weather damage. Even though soybeans are not competitive with corn in the current price outlook, harvesting standing soybeans may be worth more than harvesting lodged corn late in the season.

The physical workload demands of growing more corn will likely keep some acres in soybeans. We may be approaching an era when more farmers grow two years of corn followed by one year of soybeans. If that happens just realize it will not happen overnight. More corn will take more input money, more machinery and more labor. Your challenge is determine if the economics and logistics of raising more corn is the correct decision in your operation. If you decide to grow more corn, then careful planning for the additional investments and additional workloads are keys to successfully managing more corn.

5. Corn on Corn - Insects

Ric Bessin, Entomology

- **Corn rootworm is rarely in 2nd-year corn.**
- **Scout to know if you have a problem.**
- **Several effective management options are available.**

Continuous corn increases management requirements of insect pests, particularly corn rootworm. Traditionally, corn rootworm has been managed very effectively in Kentucky with crop rotation, and can still be managed very effectively in our state with crop rotation. There have been reports at some meetings of rootworm problems in some river bottom fields in the Green River area this past year.

Keeping a field in corn two or three years only increases the risk of rootworm damage slightly. But as fields are kept in continuous corn for longer periods of time the risk increases. Growers may begin to notice lodged corn in mid to late June as an early sign of economic damage. Once the symptoms of rootworm damage appear, there are no rescue treatments. Treatments for corn rootworm must be used before signs of damage appear.

In Kentucky, corn rootworm beetles typically lay eggs during the summer. Those eggs hatch the following spring. The larvae from those eggs feed on the roots of the next corn crop. Northern and Western corn rootworms follow this pattern. They are the most common species of corn rootworm in Kentucky.

The Southern corn rootworm (aka the spotted cucumber beetle) is much less common in Kentucky and does not follow the same pattern as Northern and Western corn rootworms. Southern corn rootworms overwinter as an adult and lays eggs in the spring and on rare occasions has caused economic damage to corn. Southern corn rootworm can be a problem in first year corn. But this insect has a wide host range,

has been here a long time and rarely causes noticeable damage to corn.

There are photos of corn rootworm adults, larvae, root damage, and lodged corn on the corn insect picture sheet on the KY IPM website (http://www.uky.edu/Ag/IPM/picturesheets/fieldcorninsects2.pdf).

Insects Confused with Corn Rootworm

Two other soil insect problems are often confused with corn rootworms, wireworm and grape colaspis. The classic sign of rootworm damage is lodged corn ("goose-necked") in the late whorl or early tassel stage. Wireworms cause early stand loss and deadhearts of developing seedlings. Grape colaspis is uncommon and most often occurs in corn following red clover. This insect is a root feeder and can kill large numbers of plants in a field.

Managing Corn Rootworm in Continuous Corn

Fields in Kentucky that have been in corn for 2 or 3 years typically do not have problems with corn rootworm. Field scouting is the best method to determine if control measures are needed for the next season of corn. If corn rootworm adult beetles were observed in the field during mid summer, then management strategies are needed for next season.

If you are planting continuous corn and you counted an average of at least one beetle per plant the previous summer, then there are three management options:

1. corn rootworm seed treatment (Poncho 1250, Prescribe, or Cruiser RW)
2. soil insecticide at planting (Force, Aztec, Fortress, Lorsban, Capture, Regent, etc. [see ENT-16 for rates and a complete list of treatments])
3. Bt-rootworm corn hybrids (YieldGard RW or Herculex RW). To date, very few Bt-rootworm hybrids have been tested in the University of Kentucky corn hybrid performance trials. Most have not performed well.

Monitor weekly for the adult beetles beginning in late June through early August to assess how well your management options are working.

Most rootworm treatments will cost between $15 and $20 per acre. Specialized equipment is needed on planters for soil insecticides applied at-planting. Seed treatments and Bt rootworm corn. Seed treatments and Bt rootworm hybrids don't require special equipment, but do require early booking of seed. Ordering either of these may be too late this year. To date, most Bt-rootworm corn hybrids have not performed well in the University of Kentucky corn hybrid performance trials.

Generally, widespread preventive treatments for corn rootworms in continuous corn are not recommended unless there is evidence of a need on a field by field basis. If a field shows signs of high rootworm risk for the coming season, consider using rotation to manage the problem. Growers wanting to grow continuous corn may benefit by keeping fields in corn for only 2 or 3 years then rotating to a non-corn crop to manage rootworms.

Scouting for rootworm beetles

Examine 20 plants per location and record insects found per plant. Select locations randomly so that they will be representative of the entire field. A minimum of 2 locations is per field. A field of 100 acres would need 9 scouting locations. Don't survey along field margins unless specifically directed to do so. Don't limit surveys to one side or end of a field. The economic threshold for rootworm control the following year would be an average of one beetle or more per plant. For a complete description of rootworm monitoring guidelines and procedures, see IPM-2, "Kentucky Integrated Crop Management Manual for Corn," which is available on line on the KY IPM website.

6. Soil Test Potassium Levels Declining in Some Areas of Kentucky

Greg Schwab, Plant and Soil Sciences

- **Soil test K values have been declining in major corn areas of Kentucky.**
- **Closely monitor soil test K values.**

The goal of soil testing and nutrient management is to avoid yield-limiting nutrient deficiencies. In Kentucky, we use a slow build-up/maintenance approach for soils testing low or very low in potassium (K). An additional amount of fertilizer is recommended to build levels toward the medium range (200-300 lbs/a). Since native soil test levels are generally medium to low, we expect a slow gradual increase in soil test K which should eventually reach equilibrium within the medium range.

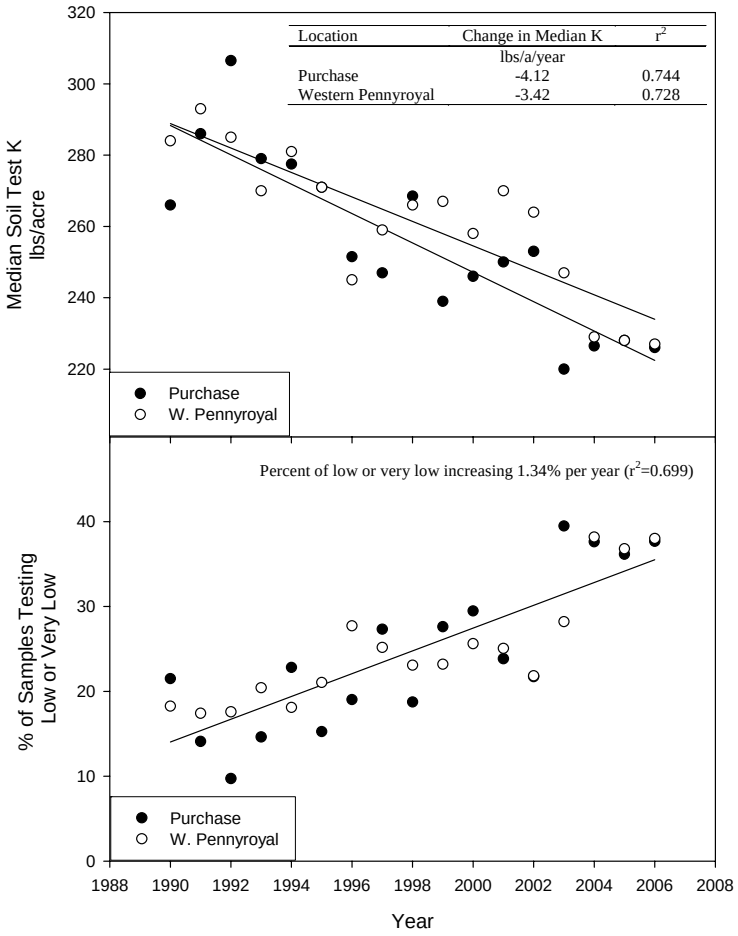


Figure 1. Change in median soil test K and percentage of samples low and very low in soil test potassium for the Purchase and Western Pennyroyal regions.

Recent analysis of samples submitted to UK soil testing labs (Lexington and Princeton) show there is a downward trend in soil test K for two of our largest grain producing regions. The only samples considered for this analysis were those having corn, soybean, wheat, or wheat-soybean as the intended crop (approximately 220,000 samples), and the median value was determined for each year in each region. The median value is the midpoint in each data set (50% samples above and 50% below).

Soil test K in most regions of the state were relatively stable, but in the Purchase and Western Pennyroyal Regions of the state, median soil test K levels are decreasing at a rate of 4.12 and 3.42 lbs/a per year, respectively (Fig 1). Furthermore, the percentage of samples testing below 200 steadily increased between 1990 and 2006. There are many factors that may be contributing to these trends:

- Lower than needed K application caused by:
  - Greater amounts of K removal (several very high yielding years)
  - Straw removal
  - Lower applications rates (high fertilizer prices; greater % of rented land ...)
- Less frequent soil testing
- Recommendations are inadequate for the sampling protocol
- Formula fertilizing using a pre-blended products (9-18-9, 10-10-10, ...)

- Improper sampling depth

Regardless of the cause, producers in these regions should closely monitor soil test K levels. If soil samples are collected this year, be sure to follow the recommendations. If you do not intend to sample fields this year and they tested below 250 lbs k/acre previously, you should apply either the previous K recommendation or removal rates (0.35, 1.1, and 0.3 lbs K_2O/bu for corn, soybean, and wheat, respectively) whichever is higher. In this time of high commodity prices, it is essential to prevent yield limiting nutrient deficiencies.

A similar study on phosphorus over the same time period indicated little to no change in soil test P values.

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